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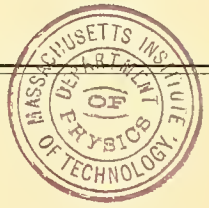


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## Electricity Applied to Power Transmission and Metal Plating in Chicago.

In these days of keen competition in manufacturing interests it is not surprising that the attention of a firm which contemplates the removal of its factory should be attracted to the subject of economy in its power machinery, as well as to the additional considerations of convenience and utility of application. This being the case, it is natural that manufacturing concerns, under these conditions, should thoroughly investigate the advantages offered by electrical power transmission over the older systems of main shaft or rope transmission. Instances of the utilization of the former power are multiplying rapidly in the West, and Chicago contains many interesting examples of the tendency of power consumers to adopt electricity. One of these is the plant of the W. S. Edwards Manufacturing company, 21 East Lake street. About a year ago the company determined to abandon its old factory on the same street, and the question of its future power was finally decided in favor of electricity, the choice being made partially because the business of the company necessitated a particularly well-lighted factory, as well as for the reason that it was decided to lease out one floor of the establishment to a concern which did not require power, and which would, therefore, look with displeasure upon shafting in its portion of the building. Of course the matter of economy was not lost sight of, and the difference in loss in transmission in favor of electricity and the flexibility of the system, enabling machines in a portion of the factory remote from the source of power to be operated when other machines nearer the generator would not be in use, without the loss of power developed and unused by intermediate shafting and belting, impressed the company so forcibly that a generator was purchased and the machinery was adapted to be driven by electric motors. The business of the company is that of manufacturing electroliers, combination fixtures, electric and combination brackets, and the plant is very thoroughly equipped in every particular, four floors and a basement being fully occupied by the company.

The generating apparatus is located in the basement and consists of a 52 kilowatt four-pole Eddy generator, mounted upon a foundation of brick and concrete. The machine is compound wound for a potential of 125 volts, giving 416 amperes at a speed of 750 revolutions a minute. From this unit about 300 incandescent lights and motors, distributed through the factory, aggregating about 50 horse power, are supplied with current. As seen in Fig. 1 the generator is belted to a jack shaft; the shaft, which was built by the Hill Clutch Works of Philadelphia, is supplied with a 56 inch pulley, and a 28 inch pulley is belted to the fly-wheel of a 90 horse power, single condensing Reynolds-Corliss engine, 16 by 36 inches, built by the Edward P. Allis company of Milwaukee and designed for 80 revolutions a minute. A battery of two tubular boilers, 60 inches by 16 feet, burning soft coal, with a combined capacity of 120 horse power, furnishes steam for a freight elevator and for heating the building as well as for running the engine. A marble switchboard, wired in multiple, not shown in the illustration, is located near the generator. It is furnished with ornamental lighting fixtures in addition to the usual instruments, which in this case consist of a Western Electric company's ammeter, a Whitney voltmeter, a rheostat, a double pole and two single pole knife switches provided with fuses of high carrying capacity. The circuits are led from the board on porcelain insulators to distributing points on the floors above, one for lighting and fan motor purposes and two for the transmission of power.

At present four motors, with a combined capacity of 50 horse power, are found sufficient to meet the requirements of the machinery, but the plant has been installed with provision for further additions. Upon the fifth floor is located the foundry and the electro-plating room, as well as the buffing machinery and a number of metal lathes. The illustration, Fig. 2, shows a 10 horse power Eddy motor belted to a line of shafting which furnishes power sufficient to run 11 lathes, an emery wheel and a 30 inch fan made by the Buffalo Forge company, which distributes air throughout the upper floors and furnishes draught for four furnaces in the foundry and a number of blow pipes and metal workers' forges. The motor runs at a speed of 1,850 revolutions a minute on a 110 volt circuit. The largest motor, Fig. 3, an Eddy machine giving 30 horse power at 600 revolutions a minute, is upon the same floor, encased in a house to protect it from the dust of the seven buffing machines which it drives. It is mounted upon a heavy timber foundation and is provided with a rheostat, switch and fuses. In addition to the buffing machinery, it drives shafting in the electro-plating room which is belted to a plating dynamo and a scratch brush, lathe and other machinery.

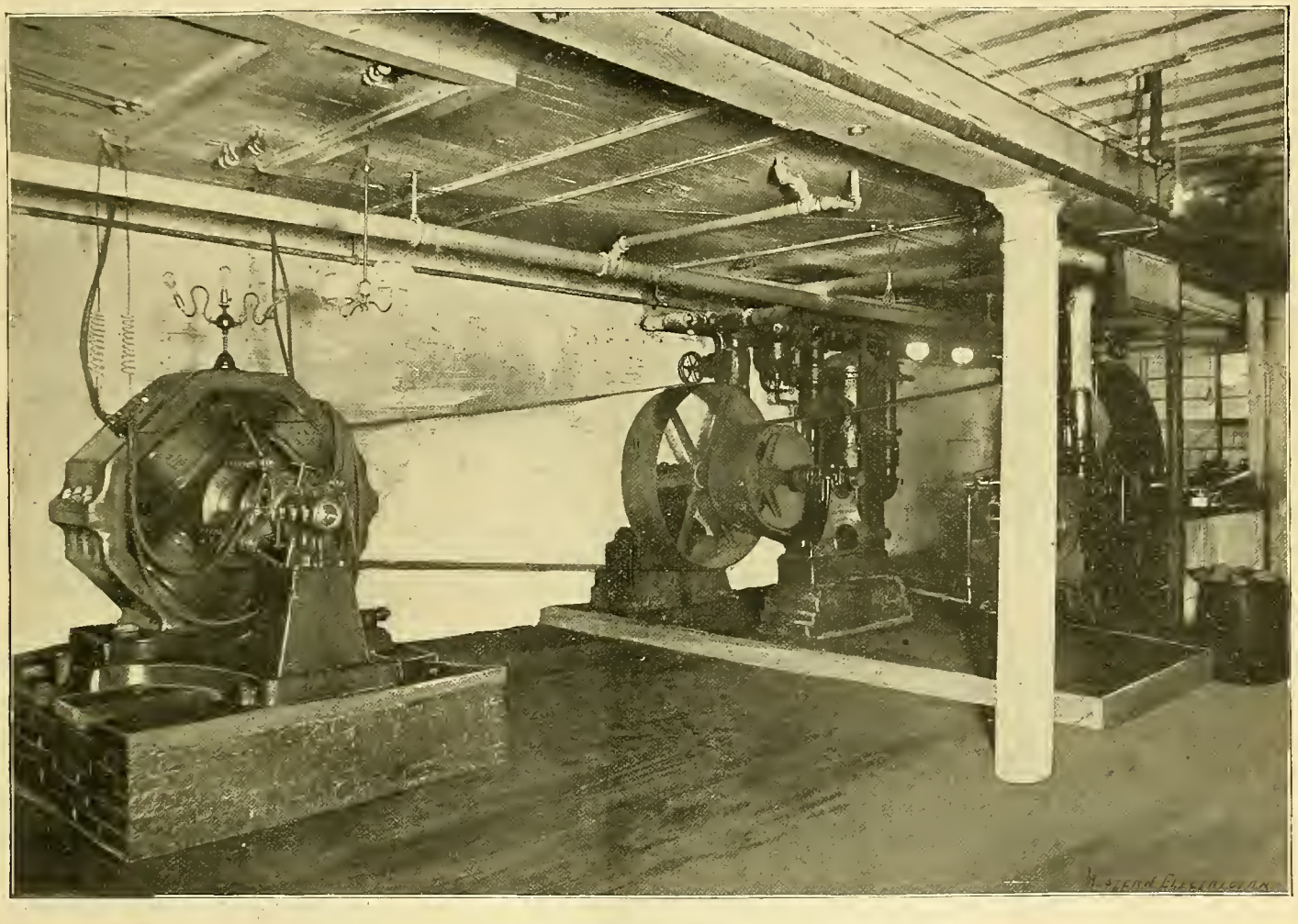

FIG. 1. ELECTRICITY APPLIED TO POWER TRANSMISSION AND METAL PLATING IN CHICAGO.

The electro-plating room is of considerable interest and is shown in Fig. 4, a Hanson & VanWinkler plating dynamo appearing in the foreground. The demands upon this machine vary according to the bath in use, some baths requiring more current strength than others and at a less electromotive force. Resistance is in series with the field and regulated so that the dynamo averages about 250 amperes at four volts. It was constructed for a speed of 1,500 revolutions a minute. Its armature is shunt wound to prevent reversal of current from the baths, and especially protected from the effects of the acids in the room. Current is led to the vats by heavy copper conductors, supported upon hard wooden insulators mounted on the walls, and is controlled and measured by a combination resistance board and ammeter. The baths, seven in number—copper, steel, nickel, nickel black, bronze, silver and brass—are contained in the vats seen in the picture. They are supported upon wooden horses and are provided with one positive and two negative conducting rods run lengthwise with the vat. When the surfaces of the goods to be plated have been prepared to receive a deposit of metal, they are hung from the cathode rod of the vat in the plating solution by lengths of copper wire of a gauge to suit the work in hand. The room is also supplied with the usual potash, cold water, cyanide vessels and oxidizing and mercury dips, iron pickles, etc.

Two Eddy motors, each of five horse power capacity, furnish the power for the lines of shafting which drive the machinery upon the fourth floor, utilized for brass spinning, brazing, etc., which consists of four spinning lathes, five brass finishers' lathes and other smaller machines. On the third floor the parts of the fixtures are assembled, wired, joined and tested for short-circuits. The second floor is leased out and the first floor is used for an office and sales-room, where many of the handsome fixtures manufactured by the company may be seen.

Charles G. Armstrong, Chicago, drew the specifications for the entire plant and acted as supervising architect, and Gustave Monrath supplied the construction work, acting as sub-contractor under the Eddy Electric Manufacturing company.

## Telephone Service on French Railroads.[1]

The value of the telephone in railroad service has been recognized ever since its invention by A. Graham Bell, in 1876, but it has been largely adopted by the railroads only during the last few years. Its use is now rapidly becoming general.

Two classes of apparatus are common—the magnetic and the micro-telephone. The former, as devised by Bell, is marvelously simple, but it admits of distinct conversation for a short distance only. By combining it with the Hughes microphone we have the micro-telephone, which, though more complicated, is incomparably more powerful. Except on roads with limited traffic and stations very close to each other, it is the only serviceable telephone for railroads. Its principal inconvenience is the necessity of using batteries, while the Bell telephone, on which the calls are made by magneto bells, do not need this accessory. Endeavors to modify the latter so as to render it more powerful have failed so far, but the researches have served to develop a very perfect instrument. Thus the magnetic telephones of the French General Society of Telephones weigh only 10 ounces, and with an aluminum casing only 4 ounces. These telephones serve as receivers for the micro-telephone stations.

Experiments in France have shown that with the Ader micro-telephone and Leclanche batteries it is possible to telephone over No. 9 iron telegraph wire, with ground return, 87 miles, and one could understand incoherently 103 miles. Repeated trials show that with standard current, over iron telegraph wire with ground return, an assured telephonic communication is not practical beyond 15 to 20 miles on telephones which are not placed in closets, but are located in naturally noisy places like the offices in stations. This is due to the excessive electrostatic capacity of iron, its great self-induction, the use of the earth as return, the induction of the telegraph wires adjoining, and other causes. The last named cause is very important, and the Rysselberghe anti-inductor system in Belgium and that of Gwozdeff in Russia partly succeed in eliminating it. The former, with which one can telephone and telegraph simultaneously over one wire of silicon bronze or galvanized steel or iron, is largely used in Belgium. With the system Gwozdeff it was possible to telephone 183 miles over an iron conductor while the telegraph apparatus was in continuous use. The French railroads have preferred to establish special telephone lines with copper wires of high conductivitity. But as these wires are strung from the same poles as the telegraph wires and are consequently quite close to them, it becomes necessary to avoid the effects of induction. This is accomplished in a simple manner by using two No. 15 bronze conductors which cross each other about every 1,640 feet. This will neutralize induction. With the bronze wire spans of 300 up to 390 feet are admissible.

*Use of Telephones on Trunk Lines.*—In France communication with subscribers of city telephone systems is limited, as the high tax on instruments compels the companies to restrict the number of installations. But for communication in the yards the telephone is used to connect the superintendent with the freight offices, switch towers, shops, etc. In certain yards even orders are given, except such as effect the safety of trains. Important messages are written down in a special book and are compared by repeating.

Some companies think of replacing the telegraph by telephone even for the transmission of important orders. There are some railroads with light traffic where the telephone is already thus used, but the entire substitution of the telephone would be difficult. The single iron conductors used for the telegraph would not be suitable, and it would be necessary to establish special telephone lines with double wire. On the Vincennes railroad in the stations between Paris-Bastille and La Varenne, which are at distances of about one mile, at a signal by telegraph the telegraph wires are connected with the telephone instruments and are thus made available for an extended telephonic intercourse. The arrangement gives excellent results. The Northern railroad of France has established on trial telephone stations on the open road along some of its main lines, through which assistance can be summoned from the stations in case of accident. The stations are equipped with telephone receivers. Portable telephone instruments are in use on some small French roads. The large Austrian railroads use field telephone instruments of the Gattinger system, which in a few minutes can be connected with the telegraph wires at any point, their use not interrupting the telegraphic communication. Under favorable conditions conversation is possible at distances up to 31 miles.

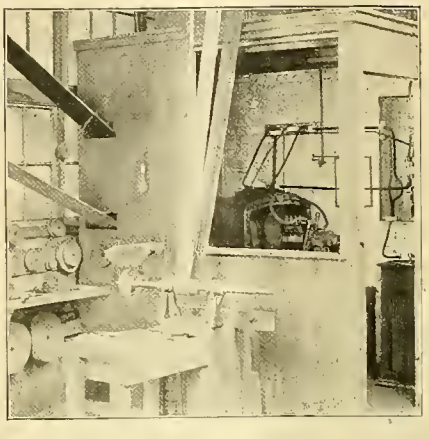

FIG. 3. ELECTRICITY APPLIED TO POWER TRANSMISSION AND METAL PLATING IN CHICAGO.

In England telephone connection between block signal stations is common. On the seven large French railroads there were in use in January, 1893, about 1,210 telephones against 5,200 telegraph stations.

*Secondary Railroads.*—It is now conceded that on secondary railroads the telephone may completely replace the telegraph. For these roads, where traffic is light and whose stations are often platforms only, an apparatus was needed simpler and more expeditious than the telegraph. The telephone has been used for the complete operation of secondary roads in Belgium. There are no buildings at the stopping places, and the telephones are placed in a locked box in a room of a neighboring tavern. Each station has a microphone, two receivers and a magneto-electric call apparatus. All stations of a road are on the same circuit. Conversation has been held between the end stations of a line 36 miles long and having 18 stations. At first No. 9 iron wires were used, but now No. 15 phosphor bronze wires of 30 per cent. conductivity are preferred. The total number of telephone stations on the Belgian secondary roads is 197, on an average 2.1 miles apart.

The total length of roads is 675 miles, of which 170 miles have iron and the rest bronze wires. In the narrow-gauge roads of the river Maass, which comprise 96 miles, the telephone is used almost exclusively.

## Electrical Purification of Waste.

During a recent discussion on the subject of electrical purification in France, M. Berger said in the Chamber of Deputies: "We carry conduits into our houses through which gas is forced, water flows, electricity, steam and compressed air circulate. Will there a day come, do you think, when we shall have a circulation of chemical fluids which will sterilize the waste products, destroy them, and return them to the Seine in an almost innocuous form? I am neither a theorist nor an empiric, and I am inclined to skepticism. Nevertheless, experiment has shown that electrolysis enjoys a role which points to this accomplishment. I cannot vouch for the ultimate complete success of these experiments, but the municipal authorities should not lose sight of them."

The experiments referred to by M. Berger are those of M. Hermite, the original inventor of the system, and of a liquid disinfectant for sterilizing the sewage of cities.

In 1893, on the occasion of the International Hygienic Exposition at Havre, very extensive experiments were made with electrolyzed water, containing about 30 grammes of sodium chloride and five grammes of magnesium chloride and calcium per liter. This was carried through the electrolytic process, and thence introduced into the waste water from the wash rooms, the street washings, the sewers and the closet reservoirs. The municipality of Havre voted a sum of money for the disinfection of the St. Francis quarter, one of the most neglected and filthy localities in the city.

It was claimed that the most offensive waste of the city, after treatment by the Hermite system, could be spread upon the soil as a fertilizer without offense, as the chlorine, disengaged by the electrolytic action, having destroyed all the germs, does not destroy the fertilizing properties. In addition to the general purification of the quarter above spoken of, M. Hermite was given in charge of the purification of seven *cabinets d'aisance* of the city hall at Havre. For this experiment a three horse power engine actuated the dynamo, which was connected to the electrolyzer through which the sea water flowed. This, transformed by electricity into a solution of chlorine, was then returned to a large reservoir, from which it was distributed through lead pipes into the sinks. The contents of these sinks flowed into an open pit or tank. Visitors at the exposition testified to the perfect deodorization of the matter experimented on. The speed of the water and the current flow were regulated in all the experiments, so that the electrolytic disinfectant contained from 0.05 to 0.1 grain of chlorine per liter. It was claimed by the inventor that the above solution, agitated in a medium infested with bacilli, absolutely destroys every germ. Not only is all fermentation completely done away with, but reproduction is impossible; the entire medium has been antisepticized.

A plant was erected near the bridge of Angouleme upon the Quai Lamblardie. Two 25 horse power engines actuated two complete groups of electrolyzers. Each group comprised a dynamo of 1,000 to 1,200 amperes capacity at a potential of 6 to 7 volts, an electrolyzer, a rotary pump and inlet and outlet conduits. The sea water was raised by pumps and delivered through the inlet pipe, while the outlet from the reservoir, 12 meters above the earth, communicated with pipes laid through the streets of the St. Francis quarter. In this conduit were placed 80 outlets for washing the gutters and the sewers of the quarter. The streets were sprinkled and the washing water was diluted with the liquid. The black mud was purified and clean sand took its place, despite the constant influx of the refuse from a population of 10,000 people.

Two houses, especially selected on account of their malodorous condition, were placed at M. Hermite's disposal. In both cases the claim seems substantiated that the disinfection of the premises was complete, and the water returned to the street after doing its work, carrying the waste with it. The public laundry near the Quai Lamblardie was furnished with the solution for whitening the linen of the establishment.

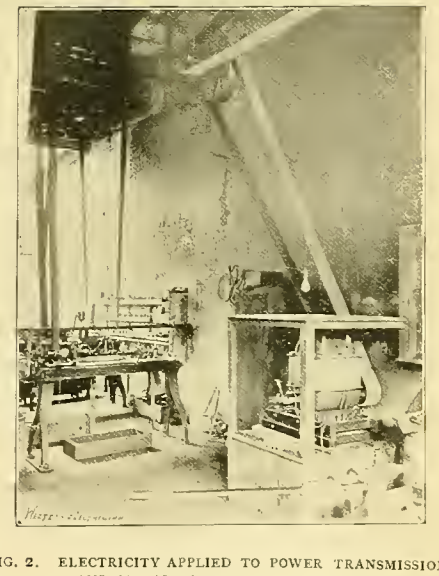

FIG. 2. ELECTRICITY APPLIED TO POWER TRANSMISSION AND METAL PLATING IN CHICAGO.

The amount of water electrolyzed in the Havre experiments was about 600 liters per minute, with from 1,000 to 1,200 amperes of current.

Several reports of distinguished authorities have been made recently on the Havre experiments, and the characteristic caution of the French scientist is prominent in these, or at least in one of them—that of the central

1. Abstract of a paper by G. Dumont in the *Memoirs* of the French Society of Civil Engineers.

consul of hygiene of Seine-Inferieure. He says in brief that the sterilization is incomplete, although the odors are annihilated, and thus far he indorses the process as having hygienic value. The report of the professor of the naval medical school of Brest, Dr. Pitou, and his assistants, is more favorable. From the experiments made he gives among many conclusions the following: That electrolyzed sea water may be transported without deterioration; that it may be concentrated for shipment and subsequently diluted with pure water for use; that its power of deodorization is perfect, its power of dissolving fecal matter or paper being *nil;* that for the sterilization a cell of 150 grammes requires—

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 liters of water of a | | | | 1 gramme solution. | | |
| 7 | " | " | " | .75 | " | " |
| 9 | " | " | " | .50 | " | " |
| 10 | " | " | " | .36 | " | " |
| 12 to 15 | " | " | " | .25 | " | " |

Dr. Pitou adds that the one gramme solution will effectually sterilize an equal volume of liquid in five minutes; and that no longer time is required to sterilize a pure culture of choleraic or typhoid bacilli, with a .75 gramme solution, but that in all cases intimate contact is absolutely necessary to success, and hence fecal matter must be diluted before treatment. Summing up his experiments, he says that otherwise it requires six liters of water at .50 to sterilize 150 grammes and two hours' contact.

A third report by Dr. du Bois Saint-Sevrin, of the marine hospital of Lorient, of experiments in the bacteriological laboratory of the hospital, sums up as follows: Pure culture of typhoid bacilli is sterilized by it in five minutes. Typhoid fecal matters sterilized in less than one hour, with slight agitation, with a .50 gramme solution, but when the test is made quietly the action is very much retarded.

The inventor estimates that for sterilizing the waste of a seaport town of 100,000 inhabitants 62 electrolyzers of 12 horse power each will be needed, with 60 horse power in pumping apparatus—a total of 800 horse power in machinery. The expense for coal, labor, etc., in distributing 3,000 cubic meters per day is estimated at 602.23 francs, or .20 franc per cubic meter. The annual expense will be 219,813.95 francs, or 2.19 francs per inhabitant.

Both sides of the question of electrical disinfection are presented in this article, the facts for which were obtained from *La Lumiere Electrique*, and the reader may draw his own conclusion from the impartial testimony. He who will so perfect or improve upon this system that the larger cities of the world can make use of it for the purification of their waste will take rank as a great human benefactor.

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At last week's meeting of the Chicago council the ordinance of the Consumers' Electric Light company of Chicago to operate in the territory named was presented: Beginning at Lake Michigan at the south line of the Chicago river and running along the south line of the Chicago river to the North Branch of the river, thence running along the west line of the North Branch to Halsted street, thence north to North avenue, thence west to the western limits, thence south to the west fork of the South Branch, thence east to Twenty-second street, thence east to the lake. The company is to erect a $60,000 plant within a year. No price of light is provided. The ordinance was referred to the committee on gas, oil and electric lights.

FIG. 4. ELECTRICITY APPLIED TO POWER TRANSMISSION AND METAL PLATING IN CHICAGO.

## Apparatus for the Measurement of Coefficients of Self-induction and the Investigation of the Phenomena of Alternating Currents.[1]

By Frank A. Laws, S. B.

The increasing use of alternating currents in telephony and electric lighting has, during the last few years, directed attention to the measurement of coefficients of self-induction. In this paper certain apparatus devised for this purpose, together with methods for its use, will be described. Further discussion of the various methods of measurement proposed and of experimental results obtained is reserved for a later article.

For investigations pertaining to telephony it is particularly desirable to measure inductances by means of alternating currents of suitable known frequencies and of the same order of magnitude as those used in practice. In all such work the reduction of the results is greatly simplified if the electromotive force employed follows the sinusoidal law.

Therefore the aim at the outset was to produce a dynamo whose electromotive force should vary in this manner, and whose frequency of alternation should be about that which is normal in telephonic work. Under these requirements there have been designed in the Rogers laboratory two dynamos or arrangements of dynamos. The first of these was planned during the winter 1890–91, and was used by L. Derr in connection with his thesis in 1891–92. This machine was provided with a stationary armature having Lord Kelvin's zigzag winding on the outer service of a hollow cylinder. This was placed in the gap between a star-shaped piece of iron and a disk with a corresponding star-shaped opening, the two pieces being similarly and concentrically placed and forming the pole pieces of the machine. Owing to the shape of the pole pieces the field between them is variable, being denser at the points of the stars, so that when the field moves past the armature an electromotive force will be set up in the latter.

One disadvantage of this design is that the electromotive force is small, owing to the very large non-effective field; for it is only the variation of the field that is of service in producing the electromotive force. By properly shaping the pole pieces a curve of electromotive force was obtained, which, when plotted, was found to be nearly sinusoidal in form.

The second machine was constructed by C. L. Norton and P. H. Thomas, and forms the subject of the present paper. The special form of dynamo used was designed in accordance with a suggestion from them. The frequency is somewhat low, being 400 complete alternations per second. When another machine is built it will be so designed that the superior limit will be raised to 2,000 complete periods per second.

Both the machine of 1890 and that of 1892 embody the same general features. Each has two independent armatures, one fixed, the other movable in phase relation to the first. This relation is capable of measurement. At the outset it was determined that in these machines the armatures should contain no iron and that they should remain stationary, in order to eliminate any possible microphonic action at the brushes.

The machine, which is shown in place ready for use in Fig. 1, consists, in brief, of two dynamos, with revolving fields mounted on one shaft to insure definite phase relation. The armature of one is fixed, while that of the other may be given any desired angular advance or retardation in reference to the first by means of a tangent screw. This advance can be read off from the graduated head of the screw. The fields are independent of one another. In addition to the dynamos the shaft carries a contact arrangement for mapping wave forms and a stroboscopic disk for determining the speed of rotation.

One of the field magnets is shown in plan in Fig. 3 and in section in Fig. 2. It consists of two star-shaped pieces of cast iron, keyed to the shaft and having hubs of such a length that the faces of the teeth are ⅞ inch apart, thus leaving a gap in which is the armature, ¼ inch thick. The castings are recessed to receive the field coils, which are about one square inch in section and contain 250 turns of No. 16 B. & S. double cotton-covered wire. The coils were wound on forms, paraffined and taped, and were inserted when the machine was assembled. The terminials are brought out through bushed holes and fastened to composition collector rings which are carried and insulated by blocks of vulcanite mounted on the tips of the teeth of one of the castings. The brushes of spring copper are supported from the base plate. The eight teeth were milled from the round by a special Brown & Sharpe cutter, and have the form of a sinusoid laid off radially from the base circle. Of course, owing to the spreading of the lines of force, the particular form to be given to the teeth in order to obtain the best action can only be obtained by trial.

The armature consists of a vulcanite disk 10¼ inches in

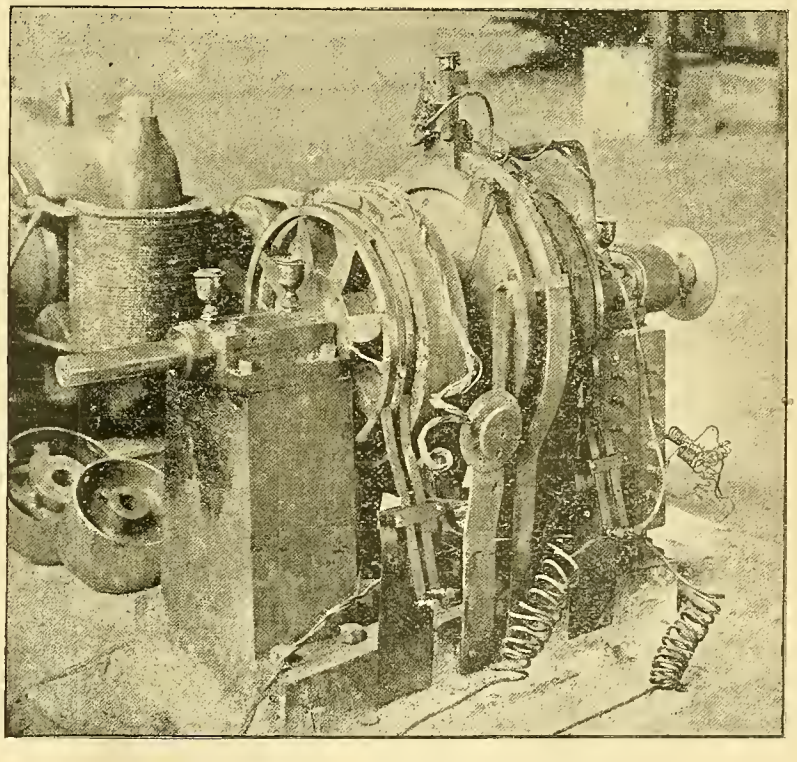


FIG. 1. MEASUREMENT OF COEFFICIENTS OF SELF-INDUCTION.

1. Read before the American Academy of Arts and Sciences, January 10, 1894.

diameter, ¼ inch thick, having a 4 inch hole in the middle. From this hole radiate 16 equally spaced saw-cuts $\frac{3}{16}$ inch deep, $\frac{1}{16}$ inch wide, and 2¼ inches long, the outer extremities of alternate pairs of cuts being connected by grooves concentric with the disk. In these cuts and grooves the armature wires are laid in shellac. The windings at present consist of three sections having respectively 10, 10, 20 turns of No. 30 B. & S. copper wire. The total resistance is about 10 ohms. The manner of winding as well as the action of the dynamo, by

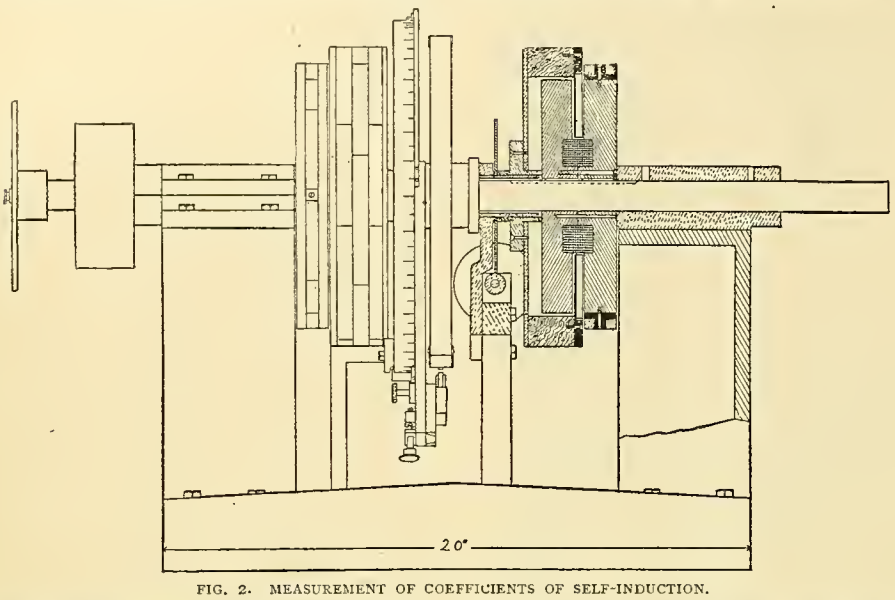



FIG. 2. MEASUREMENT OF COEFFICIENTS OF SELF-INDUCTION.

varying the length of active wire, are evident from Fig. 3. The armatures are carried by built-up hard-wood rings 10¼ inches outside diameter, 8¼ inches inside, and $1\frac{9}{16}$ inches deep. The ring in one dynamo is attached to a brass disk and hub which fit the shaft and are rigidly bolted to the frame of the machine.

In the other dynamo the armature, ring, disk and hub are attached to a worm-wheel, and the whole is movable on a sleeve supported firmly from the frame of the machine. Through this sleeve passes the shaft without contact. The worm-wheel gears into a tangent screw provided with a divided head, the gearing being such that 1° on the wave form is represented by 20° on the head. Backlash is prevented by a spiral spring. (Figs. 2 and 3.)

Between the two dynamos is a brass disk, keyed to the shaft and provided with an insulated collector ring and contact point. By the side of this disk is a radial arm, revolving freely about the shaft and capable of being clamped at any desired point to a fixed graduated circle. The arm carries the contact spring, made of watch spring and supported on its lower side very near its extremity to prevent the lengthening of the arc of contact by vibration. The spring can be moved out of contact with the point by

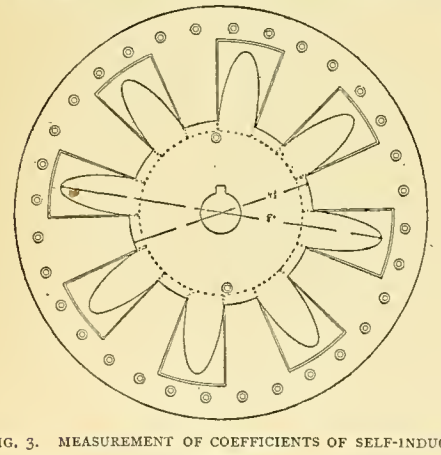


FIG. 3. MEASUREMENT OF COEFFICIENTS OF SELF-INDUCTION.

a fine-pitched screw. This contact arrangement we have found to work satisfactorily at as many as 3,000 revolutions per minute.

The shaft of the machine is of steel 1 inch diameter, 29 inch long, and runs in composition bearings, each of which is 5½ inches long. The frame of the machine is heavy, weighing 175 pounds, and is designed so as to be very rigid. Driving is effected by means of a 2 inch belt running over a 5 inch pulley. The motor, 1 horse power, is of the Sprague type. Variations of speed are obtained by the use of pulleys of different sizes on the motor shaft.

Both machine and motor rest on a brick pier, the machine being set in sulphur; mechanically the arrangement leaves nothing to be desired. It has been run continuously at the rate of 3,000 revolutions per minute without perceptible jarring.

The machine was at first supplied with a mechanical counter which could thrown on or off by means of an electro magnet operated by a key. We found, however, that the arrangement was unsatisfactory, as variations of speed were introduced by its friction and inertia. Moreover, such an arrangement gives only the average speed during a given time; we therefore abandoned this counter and adopted a stroboscopic device. A ray of light is reflected upon the revolving segmented disk from a mirror attached to an electrically driven tuning fork of known rate. With such an arrangement the desired speed may be attained and variations from it measured by noting the apparent motion of the disk.

The first test to which the apparatus was put was to obtain the judgment of a person having a trained ear as to the quality of the tone produced by its current in a telephone. His opinion was that the tone was pure, only the fundamental being detected. The wave form was then mapped,

In planning this work it occurred to us to employ the method of projection of potentials whenever it was necessary to measure a potential difference or electromotive force at any instant. The opposing potential difference was obtained by the fall of potential due to the passage of a direct current through a suitable resistance. As the opposing potential difference was not alternating, the contact arrangement mentioned was used in place of the ordinary key, and its value was determined by a suitable Weston voltmeter. This method of dealing with instantaneous electromotive forces was originally suggested by Profs. Foster and Maxwell, their object being to obtain a balance between a known electromotive force and the potential difference between the terminals of a resistance through which a current of known absolute magnitude was flowing.[1]

In order to obtain sensitiveness at the final balancing a condenser one microfarad in capacity was inserted in shunt with the galvanometer, the discharge of the condenser serving to increase the deflection. The galvanometer was of 3,000 ohms resistance. A telephone was used to obtain the preliminary balance. In Table I. are given the

TABLE I. DETERMINATION OF WAVE FORM.

| Armature A. | | | Armature B. | |
|---|---|---|---|---|
| Ampere turns, 2,875. | | | Ampere turns, 2,150. | |
| Speed, 1,465. | | | | |
| Revs. of Mic. Head. | E. M. F. in volts. | Check. | Position of Contact. | E. M. F. in volts. |
| 0 | + .49 | + .48 | 11° | +1.00 |
| ½ | — .91 | —1.20 | 10 | — .26 |
| 1 | —2.52 | —2.53 | 9 | —1.72 |
| 1½ | —4.01 | —4.01 | 8 | —2.80 |
| 2 | —5.21 | —5.19 | 7 | —3.86 |
| 2½ | —6.38 | —6.36 | 6 | —4.98 |
| 3 | —7.09 | —7.21 | 5 | —5.93 |
| 3½ | —8.04 | —8.03 | 4 | —6.75 |
| 4 | —8.61 | —8 61 | 3 | —7.34 |
| 4½ | —9.01 | —8.96 | 2 | —7.86 |
| 5 | —9.11 | —9.12 | 1 | —8.30 |
| 5½ | —9.12 | —9.12 | 360 | —8.50 |
| 6 | —8.95 | —8.94 | 359 | —8.56 |
| 6½ | —8.52 | —8.54 | 358 | —8.54 |
| 7 | —8.00 | —7.95 | 357 | —8.30 |
| 7½ | —7.09 | —7.08 | 356 | —7.91 |
| 8 | —6.11 | —6.12 | 355 | —7.26 |
| 8½ | —4.80 | —4.80 | 354 | —6.62 |
| 9 | —3.53 | —3.48 | 353 | —5.86 |
| 9½ | —1.94 | —1.96 | 352 | —4.93 |
| 10 | — .60 | — .60 | 351 | —3.85 |
| 10½ | +1.12 | ..... | 350 | —2.67 |
| .... | ..... | ..... | 349 | —1.60 |
| .... | ..... | ..... | 348 | — .32 |
| .... | ..... | ..... | 347 | + .74 |

results of the determination of the wave forms of both dynamos, one section of 10 wires being used. In the case of armature *A* (movable) a series of checks is appended. The whole series was gone through with and then repeated in the reverse direction, the person making the readings not knowing the previous results. The most probable sources of deviation are backlash, variations of field current, and change of speed. The checks show sufficient precision of the apparatus for the method of procedure to be described presently.

These results are plotted together with true sine curves in Fig. 4 and 5. The curves proved to be very nearly symmetrical, so that only one-half has been given. The saturation curve connecting maximum electromotive force and field current was taken with armature *A*. The results are given in Table II. and are plotted in Fig. 6.

TABLE II. DATA OF SATURATION CURVE.

| Speed, 1,465. | |
|---|---|
| Field Current in Amperes. | E. M. F. in Volts. |
| 3.40 | 5.56 |
| 4.12 | 6.16 |
| 4.93 | 6.74 |
| 6.10 | 7.40 |
| 7.08 | 7.70 |
| 8.06 | 8.10 |
| 9.38 | 8.52 |
| 11.12 | 9.23 |
| 14.40 | 10.10 |
| 15.00 | 10.18 |

METHODS OF USING THE MACHINE.

The following methods are all based on the assumption that we have a sinusoidal electromotive force of known

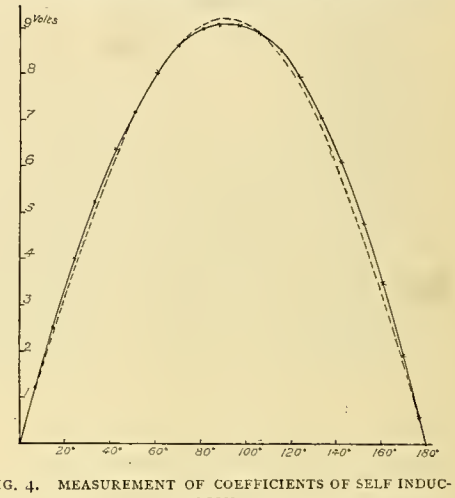



FIG. 4. MEASUREMENT OF COEFFICIENTS OF SELF INDUCTION.

period, acting in a circuit containing only true resistances and inductances. The current at any instant will be expressed by the equation

$$i = \frac{E}{\sqrt{R^2 + P^2 L^2}} \sin\left(P t - \tan^{-1}\frac{L P}{R}\right)$$

The maximum value of the sine term being unity, we have

$$\frac{I}{E} = \frac{1}{\sqrt{R^2+P^2L^2}}$$

I and E being the maximum current in, and maximum electromotive force impressed upon the part of the circuit under discussion. Also the lag between current and electromotive is expressed by $\tan\theta = \frac{L P}{R}$. From these two equations we have

$$L = \frac{E}{I P}\sin\theta \qquad R = \frac{E}{I}\cos\theta$$

Our aim is, therefore, to obtain the values of the impedance, angle of lag, and frequency, and to calculate the

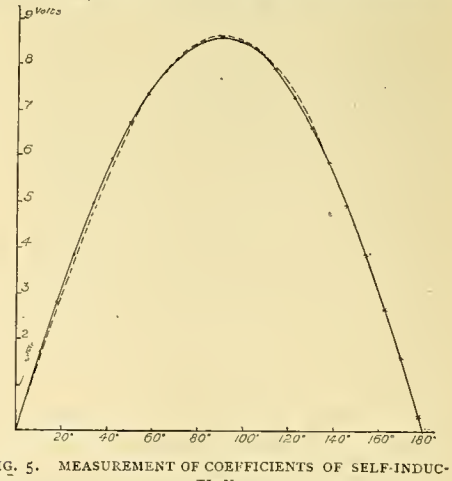



FIG. 5. MEASUREMENT OF COEFFICIENTS OF SELF-INDUCTION.

coefficient of self-induction and the resistance for any given periodicity by the above formulæ.

(*a*) If we make up a circuit of the movable armature, a known resistance of negligible inductance, and the unknown coil, all in series, we may, by means of the measuring arrangement already mentioned, obtain E and I, the latter by the maximum potential difference around the known resistance. The angle $\theta$ would best be found by taking measurements on both sides of the zeros of current and electromotive force and interpolating for the zero

1. *Telegraphic Journal*, 2, 1874, 317.

points. The difference of readings of the micrometer so obtained divided by 20 gives the angle $\theta$. $L$ and $R$ are to be calculated by the foregoing formulæ.

(*b*) If we have a carefully made plot like Fig. 6 connecting the maximum electromotive force and field current of one dynamo, we may proceed as follows: As the wave forms are alike, both following the sinusoidal law, we may apply Poggendorf's method of balancing electromotive forces directly, using a suitable telephone instead of a galvanometer. To do this make up a circuit of the stationary armature, known inductionless resistance, and unknown coil. Keep the field current of this dynamo

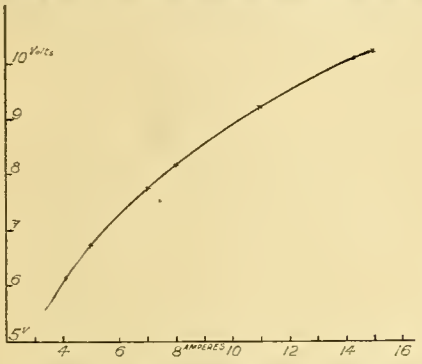



FIG. 6. MEASUREMENT OF COEFFICIENTS OF SELF-INDUCTION.

constant. Attach the second armature through the telephone, first to the terminals of the known resistance. Adjust the phase relation for a minimum of sound in the telephone; then adjust for silence by varying the field current. Read the micrometer head and value of exciting current. Repeat this process at the terminals of the unknown coil. These measurements furnish the data necessary for the calculation of L and R. $\theta$ is given by difference of micrometer readings divided by 20, as before. Owing to lack of exact similarity of electromotive force waves it would be necessary in practice to adjust by a minimum, annulling the fundamental.

(*c*) The trouble of taking the preliminary curve, as well as any uncertainty which its use may introduce, can be avoided by the connections shown in Fig. 7.

This method differs from the preceding only in the use of a derived electromotive force for balancing and in the method of its adjustment. For convenience, give $R_1$ such a value that the potential differences around $R_1$ and R shall be about equal. Adjust the phase of armature $A$ by the tangent screw, and adjust for amplitude by varying the field current, final adjustment being obtained by the slider.

Now change the connection to the terminals of the unknown coil, and again adjust for silence, making the adjustment for amplitude in this case by the slider alone. If the two values of the slider resistance are $R_2$ and $R_3$, then $\frac{I}{E} = \frac{R_2}{R_1 R_3}$. $\theta$ is given by the micrometer head as before.

(*d*) We may use a differential telephone, that is, a telephone having two opposed windings of equal influence and resistance, in the manner shown in Fig. 8.

$R_T$ is a resistance equal to that of one coil of the telephone and of negligible inductance. Adjustment is to be made until with the same value of $R_1$ the telephone is silent when in place, as shown, and when interchanged with $R_T$ then $R_1 = \frac{E}{I}$. $\theta$ is given by micrometer readings as before.

(*e*) We may also use the differential telephone to indicate when an unknown inductance is neutralized by a condenser of known variable capacity, by placing one of its coils in series with the inductance and condenser and the other in series with a variable inductiooless resistance $R_1$, shunted around the above condenser, inductance and telephone coil, if the resistance $R_1$ and capacity C be varied until silence is obtained. Then $L = \frac{I}{CP^2}$ and $R = R_1$. It will be desirable to employ an air condenser to eliminate absorption effects, though this procedure has the disadvantage of requiring a very bulky and costly condenser when small inductances are to be measured.

With this apparatus we may also determine the electrostatic capacity of a condenser when not complicated by absorption effects. For instance, by the first method we should insert in series with the condenser an inductionless resistance of such a magnitude that the angle of advance could be determined with accuracy.

Then

$$\frac{I}{E} = \frac{1}{\sqrt{R^2 + \frac{1}{C^2P^2}}} \qquad \tan\psi = \frac{1}{CRP}$$

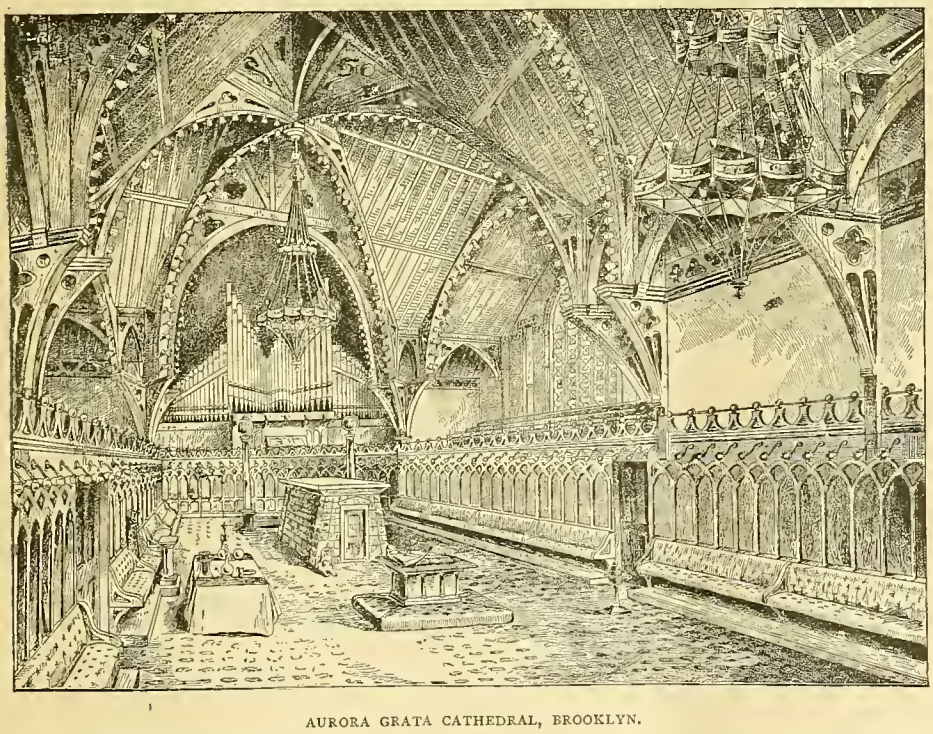
$$C = \frac{I}{EP\sin\psi} \qquad R = \frac{E}{I}\cos\psi$$

If $R = 0$, $\psi = 90°$ and $C = \frac{I}{EP}$

The above are the chief uses to which the apparatus may be put. We hope in the near future to investigate the transmission of telephonic and telegraphic signals, and to study various small induction coils such as are used in telephony, as well as the errors introduced into results by the above methods, owing to lack of fulfillment of the assumed law by the electromotive force.

## Aurora Grata Cathedral, Brooklyn.

The accompanying illustration shows the interior of Aurora Grata cathedral in Brooklyn, N. Y., which has been equipped with an electric light plant of the Edison system, with a capacity of over 500 incandescent lights. The work of wiring, which presented many problems, owing to the high arched ceiling, was done by the Complete Electric Construction company of New York, and Okonite wire was used throughout the building. The lamps are red, white and blue, covered with ornamental shades made by the Phœnix Glass company, and so controlled at the switchboard that any one color or all the colors can be used at one time, or a number of combinations of colors can be obtained, producing pleasing effects. The switchboard, which was furnished by the Brooklyn Electric Manufacturing company, is of black marble, and with its mountings forms a handsome specimen of what can be done in this line. The fire underwriters pronounced this installation as one of the best that they had ever passed on. The building is used for Masonic meetings, and among its frequenters are many well known members of the electrical and street railway fraternities.



AURORA GRATA CATHEDRAL, BROOKLYN.

## Hertzian Waves.

Prof. Elihu Thomson gives a brief account of his experience of Hertzian wave effects in the following communication addressed to the editor of the *Electrician* of London:

In the issue of your valuable paper of June 8, 1894, under the heading "Hertzian Waves at the Royal Institution," you take occasion to remark: "It is wholly probable, as Dr. Lodge suggests, that Hertzian waves may often have manifested themselves in physical laboratories to the annoyance of the workers," etc.

I may mention in this connection that in 1877, if I remember the year correctly, while working a Ruhmkorff induction coil, one terminal of which was grounded and the other terminal of which was attached to an insulated metallic body, Prof. Houston and I noticed that when the sparks were passing between the terminals of the coil,

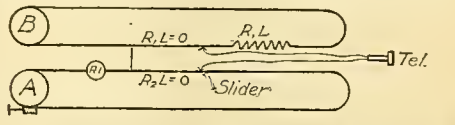



FIG. 7. MEASUREMENT OF COEFFICIENTS OF SELF-INDUCTION.

it was possible not only to obtain minute sparks from all metallic bodies in the immediate neighborhood, that is, in the same room, but that delicate sparks could be taken by holding in the hand a small piece of metal near metallic objects in many other rooms and on different floors in the building, although the pieces were not connected to ground. These could only have been Hertzian effects, but there was no recognition of their true character at the time, though the effects were seen to be connected with the very quick charging and discharging of the insulated body. An account of these experiments was, I think, published in the *Journal of the Franklin Institute* at the time.

I desire also to mention, as coming under my notice with the past year, a curious and rather amusing illustration of the principle upon which the beautiful instrument for detecting the presence of electric oscillations devised by Dr. Lodge, and called by him the "coherer," is based.

It was reported to me when in Philadelphia that a certain electroplater had found that he could not pursue his silver plating operations during thunderstorms, and that if he left his plating over night and a thunderstorm came up the work was invariably ruined. I was disposed to be thoroughly skeptical, and expressed my disbelief in any such effect. Being urged, however, I went to the silver plater's shop, which was a small one, and questioned the silver plater himself concerning the circumstance which had been reported. While it was evident that he was not a man who had informed himself electrically, I could not doubt that, after conversation with him, he had indeed been stating what was perfectly true, namely, that when his operations of plating were going on and a thunder storm arose, his batteries, which were Smee cells, acted as though they were short-circuited, and the deposit of metal was made at too rapid a rate. The secret came out on an inspection of his connections. The connections of his batteries to his baths were made through a number of bad contacts, which could not fail to be of high resistance under ordinary conditions. I could readily see that virtually he was working through a considerable resistance, and that he had an excess of battery power for the work. Under these circumstances a flash of lightning would cause coherence of his badly contacting surfaces, and would improve the conductivity so as to cause an excessive flow of current, give a too rapid deposit, and, as he put it, "make the batteries boil."

The incident suggests the use of Dr. Lodge's ingenious

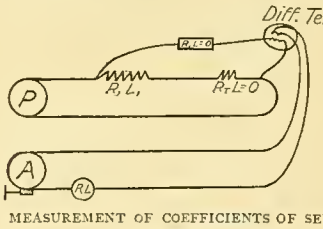



FIG. 8. MEASUREMENT OF COEFFICIENTS OF SELF-INDUCTION.

instrument in the study of the waves which are propagated during thunder storms, of which waves we have practically little or no information.

## Northwestern Electrical Association.

The summer meeting of the Northwestern Electrical association will be held at St. Paul, Minn., on July 18th, 19th and 20th. There is excellent promise of a large meeting. At the last meeting, held in Milwaukee, 105 members and visitors were present, and a larger number is expected at this meeting. Representatives from Illinois, Iowa, Michigan, Wisconsin, Minnesota and North and South Dakota have written that they will be present. An excellent programme has been prepared, and the best expert and electrical talent of the United States has been secured to address the convention. Current will be furnished to illustrate lectures as well as to accommodate exhibitors. Manufacturers and supply houses will be accorded every courtesy by the association.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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UNDER date of June 8th the *Electrician* of London gives this information to the public: "We hear that the Western Electric company are fitting up their Chicago factory with separate electric motors to drive the various machine shops, thus obviating the necessity of having large belts and long shafting." Our esteemed contemporary is a little late with its news, as it may judge by referring to the WESTERN ELECTRICIAN of April 21st. Portions of the power transmission plant have been in operation for a long time, and the whole equipment was described and illustrated in this journal at the time mentioned.

IF the electrical purification of sewage can be shown to be an efficient and practicable method of meeting the problem of waste disposal in seaport towns, the invention will be hailed as one of the greatest importance. An impartial resume of the experiments undertaken in France is given on another page of this issue, and, as the conclusions reached are as valuable in America as in France, they should be carefully studied. A positive statement of the merits of the plan cannot now be made, but the results already obtained are so promising that an exhaustive trial should be made.

THE bright prospect of an immediate demand for electrical machinery for the power plants of elevated railways was editorially considerd in this journal last week, and the outlook is made still more encouraging by the report which now comes from New York that the Manhattan company is closely watching the progress of the plan of electrically equipping the Metropolitan road in this city, and is likely to adopt electricity if it proves successful in Chicago. That such success will follow the operation of the Metropolitan road can hardly be doubted, and altogether the outlook for electrical extension in this field is decidedly gratifying.

UNLESS this paragraph should fall under the frenzied eye of the *Electrical World* in one of its conniption fits, we expect no challenge to the statement that this is very warm weather. With the mercury in the thermometer ricochetting between 85° and 95° it costs an effort to superintend the details of a central station or "hustle" for manufacturing or supply business. No apology is needed, therefore, for the specimen of hot weather electrical literature which is given in this issue. "How Garnesdon Got Electricity," for which we are indebted to the *Electrical Engineer* of London, gives no valuable information or recites no useful experience; it is simply an electrical story. But it is one of the cleverest productions of the kind that we have seen, and will be found an entertaining diversion in the dog-days.

THE World's Fair introduced into the United States a new form of spectacular entertainment, the electric scenic theater. The use of electric light to simulate natural light, with the natural gradations from dawn to mid-day and then to twilight, followed by moolight and twinkling stars, proved very attractive, and a display of this kind in the electricity building easily excelled all other exhibits in point of popularity. The accessory scenery was dainty and pleasing, and the whole show provided agreeable entertainment for a quarter of an hour. The idea of an electric scenic theater is, of course, subject to infinite variation, and the accessories may be more or less elaborate. Several exhibitions of this character have been given in Chicago since the close of the exposition, a small fee being charged in each case, and the idea seems to be spreading.

FRANCE has not proved a particularly good field for the overhead trolley system, but there is reason to believe that the advantages which it offers in the way of economy of operation and the superiority of the service which it gives will do much toward overcoming the prejudice that has heretofore been exhibited against it. The newly equipped line between Lyons and Oullins, which forms part of the system of the Lyons Tramway & Omnibus company, is about three and a half miles long and was formerly operated as a horse car line. There was a very heavy grade, however, which proved very trying to the horses and wearisome to patrons, as the cars traveled very slowly. Under the new arrangement much higher speed is maintained and the comfort and convenience of passengers are accordingly increased. It is interesting to note that the electrical equipment was furnished by an American company and the apparatus is proving entirely satisfactory.

A CURIOUS fatality which occured at the Norfolk navy yard on June 20th forcibly illustrates the necessity of guarding against atmospheric electricity in working about the great masses of steel that go to make up the modern warship. It appears from the account received that the steel cruiser Raleigh was in the wooden drydock at the time and a number of men were working on her hull when a thunderstorm came up. The workmen sought shelter beneath the vessel, which rested on blocks in the center of the dock. Suddenly, without warning, two of the men fell dead and most of the others were knocked senseless by an electrical discharge. The officers of the vessel, who were sitting about on deck, did not feel the shock, but all the compasses and similar instruments were affected, and the vessel has been permanently magnetized in such a manner as to render the electrical apparatus useless without considerable repairs and adjustment. The explanation that is offered for the escape of the officers of the vessel from the shock is that the Raleigh was insulated by being on blocks which were dry, while the men who were killed or injured were in the shallow water on the bottom of the dock.

THE postmaster of Chicago has announced his determination to utilize the street railway systems of the city for improving the mail service. There is no reason why this should not be done in all cities having electric and cable lines, as many advantages would accrue. The postal service would be benefitted; it would be a great convenience to the public, and would not subject the company to any considerable expense or annoyance. But by far the greatest advantage would be that gained by the companies in having their cars recognized by the government as mail carriers. It would relieve them of much worry and annoyance to which they are now subjected whenever there are any labor troubles. It has been a common practice on the part of striking employes to intimidate other workmen who were willing to continue in their positions or fill the places of the strikers. Many methods have been employed to bring street railway companies to the terms of the strikers, and a favorite device resorted to heretofore has been the obstruction of tracks and other means of interrupting the service. It is believed that strikers would hesitate before violating the law regarding the transportation of the United States mail, as they have great respect for the methods employed by the Federal government in punishing offenders.

THAT several of the concessions devoted to electrical enterprises at the World's Fair proved to be not only among those which attracted the most attention from visitors, but also very profitable to the exposition management, is proven by the detailed statement recently made public by the treasurer of the exposition, showing the amount collected from each concession by the department of collections and the treasurer. The total amount paid in from all the concessions at the fair, after deducting allowances, is $3,543,612.04, ranging in amounts from 94 cents to $296,760.90. It is interesting to note that the Electric Launch & Navigation company, which operated the popular electric launches on the lagoons, turned into the treasury of the fair $110,615.18, while the Intramural company was obliged to pay $128,406.45 for the privilege of operating its trains. The electro-plating exhibits netted the fair $738.12, while the graphophones, as exhibited by the American Graphophone company, contributed $8,088.97 to the general fund, and the phonographs, scattered throughout the grounds, yielded $10,459.54 to the fair. The electric scenic theater management paid $7,078.07 for its concession upon the Midway, and the Electric Scale company gave as its share $3,766.14. O. Anschultz, the owner of the tachyscopes, which divided attention with the phonographs, paid $1,472.01. In all the electrical concessions paid to the Exposition company a total of $270,624.48, and as the amount paid was based upon the gross receipts of the several concessions, it will be seen that these electrical features were extensively patronized.

AN interesting feature of the electrolysis question in connection with escaping current from the earth returns of electric street railways is the assertion coming from several cities, notably Brooklyn, that there is enough stray electricity saturating the ground so that, if properly corralled, power sufficient to work sewing machines and other light apparatus may be secured from the earth. Gas and water pipes, then, in addition to their conventional functions, may be considered to offer their friendly offices in making available in households this subterranean reservoir of electrical power. The Brooklynites have been discussing the possibilities of the situation with much interest, and one New York paper has interviewed the general manager of one of the railway companies. He admitted that he had heard the stories of power being obtained by hitching wires to water and gas pipes, thus running fans and light machinery, but he denied positively that such a thing was possible with any current which could have escaped from the wires of the trolley system. "Why," said he, "just think of the enormous quantity of electricity which has been dumped into the ground in years past by telephone and telegraph companies and private plants all over the city. There is, no doubt, lots of electricity in the ground, and if a circuit should be established between two pipes of good conductivity and a fan motor or something of that sort connected with the circuit, there is no reason why it should not work, but use our current—oh, no. In the first place, a large part of our current is returned to the generators by means of overhead wires running parallel with the feed wires, these being connected at intervals, with the ground wires laid between and connected with the rails. The rest of the current is returned by the ground wires direct. If there is any absorption of our current by the ground it must be infinitesimal, as if it were of any appreciable amount it would be known in our power house. And another thing, if enough of our current escaped to run even a small motor it would be unsafe to touch it. Our voltage is 500, and a fraction of the current has the same voltage as the whole. For a man to hitch a five-volt motor on to any of our current that he could reach would be madness. His machine would go to fragments like a piece of fireworks." But while the experts disagree as to the responsibility, the newspapers that have undertaken the task of investigation appear to have little doubt that the people of Brooklyn are living over what may be termed a sort of "salted" mine of electricity, while they appear to doubt whether this state of affairs is a blessing or the reverse.

## How Garnesdon Got Electricity.[1]

It may seem to have been a very simple proceeding to those who knew Garnesdon about four years ago—very simple indeed. A company was formed, and an experimental installation was fitted up and successfully run for three months, after which permission was given to the company by the local board to light the public streets and supply private consumers.

That is all that seems to have occurred in connection with the successful flotation of the Garnesdon & District Electricity Supply company, limited, and if it were not that my conscience troubles me a little during my siestas here in Rosario, that is all that the public would ever know about it, more particularly as the late engineer to the company died a few months ago.

Four years ago I was just out of my time with a firm of electrical engineers, and on the lookout for a chance to add M. I. E. E. to my signature, and at last, in answer to an advertisement for "a young man with knowledge of practical electricity," I got work in Garnesdon.

It seems that the local board of that place had had a disagreement with the gas company, and being treated highhandedly, had secured a provisional order for electricity. This kept the gas people in order for a while, and in the interim the surveyor and the members of the electric light committee of the local board had been bombarded with the tracts and pamphlets of manufacturers of every article that could claim a smiling acquaintanceship with electricity, in addition to which martyrdom in the interests of the community they had felt it only their duty to accept as many invitations to visit central stations and factories as could conveniently be managed, which is a very thirsty and exhausting process, as is well known. The local board were a trifle shy about making use themselves of the order, so, as soon as the hospitality of the electrical profession began to wane, the order was turned over, with the consent of the Board of Trade, to a company which had been formed with this result in view. The terms of the transfer included a proviso that the three months' trial should be successfully gone through before the complete ratification of the transfer. This was at the instance of the chairman of the local board, who was connected with the gas company. The electricity company thereupon offered to perform the trial upon his own premises, confident that good workmanship and careful operating would convert even a gasman. The offer was accepted, and the immediate result of the negotiations was a first-class dinner to celebrate the first stage of the transfer, given by the company to the board and its wives.

When I came on the scene a week or two after, I found the work of altering a mill on the bank of the river into a central station well in hand. The engineer to the company was a practical mechanic and had a good working knowledge of electricity. He got out the plans of everything, arranging to have the machinery run by turbines, which replaced the old mill wheel. A consulting engineer verified his calculations with regard to the electrical plant, which he had chosen with a view to the utmost simplicity in working. The turbines would drive 110 volt alternators, the current from which would pass from the omnibus bars into low-tension mains for houses in the vicinity of the station and also into a step-up transformer at 2,100 volts for feeding banked transformers placed where distant groups of houses would require current. House transformers would also be used on this circuit, where the demand was scattered.

It will be seen that the company was very sure of securing the ratification of the transfer, as, in addition to the elaborate preparations at the station, they had decided to lay the mains underground to the chairman's house. This would, of course, be best for a permanent job, but a much heavier debt would be incurred in the event of the withholding of the transfer than if overhead wires had been used. The conduit consisted of two ducts 2½ inches square upon the "Johnstone" system; the high-tension feeders would be drawn into one of these ducts and the low-tension mains into the other. For the present iron drawing-in wires were laid therein, as the cable had not been delivered. There had been a little controversy as to the preferability of twine for this purpose, but it was finally decided to use No. 12 wire, and drawing-in boxes were put down at 100 yards intervals.

The chairman's house was about half a mile off, and was to be lit during the three months trial without using transformers, this course being considered safer, and the high-tension $\frac{7}{16}$ cable was to be used for the transmission, being plenty large enough to carry the current for the 50-light installation. Everything, at last, being near completion except the wiring of the house, I took that in hand, while the engineer got things shipshape at the station.

My job was a very pleasant one. The household consisted of Mr. Rogers, the chairman of the local board, and Evelyn, his daughter, together with an aged housekeeper and the servants. The daughter was a sweet young thing of about 20 and seemed entirely free from the affectation that prevails so generally among women of the middle class. This probably could be accounted for by reason of her mother dying while she was yet a baby, and she had therefore to read the world chiefly through her father's mind; a man, of course, having less finnicking ideas about things than a woman, especially a middle-class woman. The lack of the maternal control could be seen, too, in the whirlwind-like way in which she went about the house. One day I had just started on the drawing-room and was at the top of a ricketty step-ladder behind the door with joy in my heart and in my mouth many nails, when an invisible force communicated to the door sent the ladder to the other side of the room. I went as well, and performed the latter half of the journey on my head.

When I came to, the housekeeper and Miss Rogers were picking the nails out of my tongue and gums, while the servants were standing around with wide-open eyes. It was very pleasant for me, especially when the nails came out easily, and I lay there till they were all extracted, listening to words of sorrow and apology from the Rogers girl. I couldn't say much in reply for a long time, by reason of a crucified tongue; and when it was at liberty my efforts at pronunciation were so realistically similar to the immediate effects of a champagne supper that I hailed the doctor's advent with relief, and was straightway ordered off home to go to bed and poultice my mouth.

Next day I felt all right, so started work at the house again. Half way through the morning a dainty rap sounded on the door. I climbed down hastily from the ladder and opened. The whirlwind was there, looking more like a penitent zephyr, however.

"I am so sorry to have hurt you yesterday," she said. "It was so thoughtless of me not to remember that you were in the room at the time. I hope you are feeling better to-day."

I said something about the pleasure of being made a ninepin of occasionally, and that she was very kind to risk her fingers between my teeth after the nails.

"And that is what I want to speak to you about," she continued. "Why on earth do you put nails in your mouth?"

I explained that the average man being only possessed of two hands, it had become fashionable among wiremen to utilize the mouth, so as to overcome this lack of foresight in the design of mankind.

"But I'm sure they must taste nastily. Do you wash them first?" she asked.

I assured her that a self-respecting wireman washed his nails morning and night—I did not specify the brand of nails—but promised in future to carry them only in my pocket, to prevent accidents.

After that we used to chat together very often when her father was out. It was well known that he wanted the light to fail during the trial so that he would have a good excuse for withholding the confirmation of the provisional order's transfer; consequently, he did not waste civilities upon myself. But his daughter was very nice, and took an absorbing interest in every item of the work, from the connection leads to the last lamp, and she saved me a lot of trotting up and down ladders to get tools and things. Sometimes she would get inquisitive concerning the inner workings of apparatus and the reasons therefor, whereupon I would stay my hand in its work, sit on top of the ladder like a heathen god on its altar, and tell her all I knew about it. If the day was sultry, the explanation would become very minute and of a Munchausen character; but even on days when the spirit of industry was at its strongest, the sight of a fair maiden, leaning against something that matched her dress and drinking in with upturned face the words of wisdom that came from the topmost rung of the stepladder, was enough to make the description of even a humble ceiling-rose a theme which could not be dismissed under an hour and a half. Oh! it was very nice; and perhaps if the housekeeper had not frequently found excuses for Miss Evelyn's presence elsewhere, I might have been still on that stepladder declaiming the virtues of cut-outs and double-break switches. I noticed then, with sorrow, that old Rogers was extremely unreliable—with regard to returning home, I mean—and could never be absolutely depended on to turn up within an hour either before or after the time at which he was expected. There were some very near squeaks sometimes in consequence of this, but usually when he came round to inspect progress my hammer was making the house echo and the piano was making the hammer feel ashamed of itself.

All jobs, even 50-light jobs, must come to an end at last, but it couldn't be helped under the above conditions and with the unfeeling engineer on pins to start his machines. If it had not been for the vital importance of the trial, I fancy that the cut-outs in the house of Rogers would have needed pretty frequent repairs; but I nobly withstood the temptation to put weak fuses in, and thus risked the chance of not seeing so much of Evelyn.

However, fortune favors the virtuous, and it was a weird day during the next few months that we didn't manage to run across one another "quite promiscuous like" on the high road or in one of the pretty meadow paths in the vicinity. Old Rogers was understood to be very wroth when these meetings reached his ears, but his daughter had a will of her own and—well, perhaps he knew her better than I did.

As soon as the house was finished and the last connection made to the station switchboard, we saw all clear in the dynamo-house, put a tub of salted water into the circuit, and opened the turbine gate. The main switch at the house had been previously closed, so that we had just the line and resistance in circuit, and great was our joy to find the voltmeter finger point to 110 as we gradually lessened the resistance. Next day the trial commenced in earnest, from sunset to midnight, as agreed upon, and everything ran sweetly.

It was very easy work now, and would be till the end of the trial, when, if successful, we should put down two more 25 kilowatt alternators; mains would have to be laid throughout the compulsory area, and transformers put down—one at each side of the upper town and three in the lower.

One day I persuaded Evelyn to visit the works, and introduced her to the engineer, who showed her all over the place and quite eclipsed the glories of her scientific experiments on making switches spark at home by letting her work the adjusting screws of an arc light frame which he had put together while we ran the exciter on to its terminals. After that she often dropped in, and learnt the names and uses of everything in the station. She was very useful, too, at times; when an instrument would require tinkering up, her delicate fingers would make short work of what to either of us would have been a most sweatful and laborious job, provocative of free and easy blasphemy. In fact, she got so eaten up with the attractions of the works that we had to keep our eyes perpetually on her to prevent her from opening the turbine gate when the machine was on dead short-circuit or from making impossible joints on spare cable, which process stained her dress and ruined the whiteness of her fingers.

All went well at the works for about nine weeks. No complaints had been made of the light not being bright or of it flickering, which was not very strange, even when old Rogers played the goat with the big electrolier switch, evidently to try and jerk something wrong, as Evelyn would tell us; we always ran the alternator at nearly its maximum speed, and the excess current went into the salt-water tub, which was an effective deadener and cost us nothing more. We got so cocksure of ultimate success at last, that we sometimes dispensed with preliminary runs before sunset and only started our machines when twilight came. This only happened if we were both away during the day, as sometimes happened if there was something on in the neighborhood, such as a picnic or an agricultural show, when we would lock up the place early in the day and get back before sundown. In fact, it was so deadly slow just then that we may be excused for getting out of sight of sleepy Garnesdon occasionally. There was little to do beyond testing the machinery and the circuit, and this duty was usually performed about mid-day, and was sometimes witnessed by members of the local board passing at the time. Old Rogers, the chairman, often looked in during these operations and picked his teeth meditatively. Once he dropped his silver toothpick near the alternator and the engineer swore that he tried to drop it into the field, and ever afterward kept a wary eye upon him.

One day a grand Primrose league garden party was to be given at Storton, about 15 miles away, which was the event of the year. People came to it from all parts of the county, but it was very select. Evelyn had told me that she was going, but that her father would have to go to London that day. This was maddening to me, who, of course, had not been invited. The engineer's best girl was also going, and as her parents were not sure of accompanying her, it was likely that the two girls would drive down together. Consequently the engineer and I were in a very vicious state of mind, and on the morning we awoke with heavy hearts rather earlier than usual. I went to my window to see if our charitable prayers for wet, steaming, dismal weather were going to be answered, but was disappointed. The early morning sun was shining with a stolid German persevernce that betokened a cloudless day. Coming down the road was Mr. Rogers, with a bag in his hand, looking very flushed and heated, and evidently on his way to the railway station. No one else was in sight as far as I could see from behind a crack in the blind. Within 20 yards of the works he stopped behind the hedge and wiped his perspiring face with his handkerchief and then fanned himself vigorously. I still watched curiously; it was such an odd thing for a man to do after a five or ten minutes' walk from his house. At last he resumed his journey, evidently feeling less heated, but instead of passing on he went to our gate and pulled heavily at the bell. I slipped on a dressing gown and went downstairs, wondering what could have happened to the light the night before. He was just giving the bell another tug and seemed surprised at my prompt appearance.

"Good morning," he said. "You sleep lightly, young man. I've got some spare tickets for the Storton garden party to-day, and if you and your chief would like to attend it you are welcome to a couple."

I thanked him with fervor, and he continued: "My daughter and Miss Hearne are going down in the trap, and as it might be awkward for you to get there by yourselves, you have my permission to drive them down. You or Mr. Holloway can drive, I suppose?"

I said "yes," but I meant dynamos.

"Well," he said, "don't start later than nine or you'll miss the luncheon. You can return in the trap when you please for your duties here and have it sent back for the ladies."

I was redolent with gratitude and invited him inside to endure the pouring forth of similar sentiments from the engineer.

"No, thank you," he replied. "I only just have time to catch my train. Hope you'll have a pleasant time; you hard-working fellows deserve it. Good-bye," and with that he was off.

The engineer had heard the conversation, and when I burst into his room had forsaken dignity and bedclothes, and was standing on his head.

"Well, I'm blowed!" he exclaimed, finally resuming the respectability of the horizontal plane. "I never credited the man with being anything better that a pirate with a pretty daughter. My conscience, won't we enjoy our young selves?"

I told him of the long time old Rogers had stayed outside before calling, and how inexplicably hot he seemed [illegible] he, but the only conclusion we could arrive at was th[illegible] had had to call somewhere else after leaving his ho[illegible] was perhaps too regardful of his dignity to call [illegible] his then state of towzled perspiration. At [illegible] hadn't much time to waste talking, and our [illegible] were pretty busy during the next half-ho[illegible] fasted as usual at the King's Arms, [illegible] house in good time. The girls wer[illegible] we went, the engineer and Miss H[illegible] and Evelyn and myself behind. [illegible] on the box seat.

Of the beautiful time we had [illegible] for me to speak. The progr[illegible] that day it is not necessary indicate it. Luncheon, ter[illegible]mme thereof may sufficiently tete-a-tete, refreshments, [illegible]ais, tete-a-tete, dinner, croquet, time for the engineer a[illegible]ooating, tete-a-tete. Then it was especially as Evelyn [illegible]d myself to come away; the more was to be held at t[illegible]ad told us that a little dinner party would be coming [illegible]e house that evening, and the lights on early. Her father had told her to please herself [illegible]about attending the dinner, as it was a purely mascu[illegible]ine gathering, but she decided to return, as did Miss He[illegible]arne, which was so much nicer for us two men.

The return journey was too soon over; we dropped Miss

1. From the London *Electrical Engineer*.

Hearne at a house just outside the town and drove straight through to the works, as Evelyn wished to see the machinery started. It was only half an hour to sunset, and as we approched our destioation we noted the rustic beauty of the immediate neighborhood of the transmogrified mill, the dazzling glory of the setting orb, and the general peace and quietness that prevailed. The engineer waxed cynically practical: "It's a good job for us the sun does set sometimes," he remarked; "precious little electric light would be wanted if it didn't."

Evelyn said that he reminded her of a depraved man her father knew, who built fire-engines and saw no beauty in other than wooden houses.

When we get to the works we were nearly stifled by the beat inside. The baking sun had been pouring down on the roof of the dynamo house all day, and had converted it into a first-class oven. We opened the windows and sat down by the switchboard. Evelyn said, "I *should* like to start your machines to-night. I'm sure I could manage it all right."

Evelyn's desires were usually laws to us so, though it was too early to start, I went to the sluice valve and polished the wheel with some waste, adjusted the resistance for no load and stood by while she screwed the valve wheel round slowly, watching with evident delight the gradual revolving of shafting and increasing hum of the alternator and exciter.

"Whoa!" suddenly shouted the engineer rather impolitely. "Turn it back quick! You'll burn the blessed things up!"

I looked around. Sure enough the armatures were revolving at an alarming rate, and yet the valve wheel was not sufficiently unscrewed to account for this. Evelyn reversed the wheel and we looked at the voltmeter, which read *nothing!* This was strange, since even then the tachometer was reaching 150, and I went around to all the connections and switches to find the cause of this open circuit. Everything seemed right, and, in response to my look of inquiry, the engineer whistled the ⌒—like whistle of a man in doubt.

"Do you think that your man has forgotten to close the main switch at your house?" he asked Evelyn, "or perhaps he has opened it too soon?"

"I don't think so," she replied; "Henry is such a methodical man. But I will drive there and see."

"Thank you," said the engineer. "You had better go, too, Tom, and see if the fault is at that end of the line. Make haste back if it isn't."

I helped Evelyn into the trap and we drove at a break-neck pace to the house, and went through the side gate to the switchboard shed. The switch was closed, as we had arranged to always have it during the day to enable us to test the line properly, and the ends of the cable were securely sweated into the thimbles at the back. A hasty glance assured us of both these facts, and a growing conviction that the trouble was on the line forced itself upon me. Evelyn grasped the situation immediately, like a true woman.

"Come back to the works," she exclaimed, "and see what is to be done;" and we got into the trap again and went back at full gallop.

Evelyn was quite as excited as I was, and seemed to realize as plainly the probable consequences of a non-supply of the light.

"I hope you will find what is wrong," she said. "Three of the men coming to dinner to-night are on the local board, and two of the others are connected with the gas company—directors, or something; and you can imagine what they will say if the light fails. Even if you never have another accident in the three months, the possibility of such a thing happening will be apparent to them, especially now when all is in your favor at the works."

I groaned inwardly and cursed the Primrose league, and all that therein is, which had led us away from the path of rectitude and of regular machinery testing. The horse would have cursed the Primrose league, too, if he could have traced to that body the reason for the wild slashing he got till the works were reached.

"Well," anxiously inquired the engineer, who was waiting outside; "anything wrong at the switchboard there?"

"No," I answered; "it must be a break on the line, I'm afraid."

"My conscience! A break on that 2,000 meg. concentric! Not the sign of a leak yesterday, was there?"

"Not a scrap. Shall I go out and try to find it?" I asked him.

"I don't fancy there's time," looking at his watch and at the sun setting through the trees. "Even if you found it immediately, which there isn't much chance of doing, it would take you the best part of a day to make anything of a job of the thing. Must be a pretty clean break, you know, or part of the outer concentric would have given us some kind of return."

"And we haven't got a piece of spare cable over 20 yards long," I said, after rummaging through the storeroom. "We should just have time to run it over the fields to the house if we had; though it would not help matters much if Mr. Rogers got to know that we had to use make-shifts."

Evelyn had been peering in among the stores, too. "Why won't that do?" she asked, pointing to the length of drawing-in wire which had been coiled on a drum after being used to get the cable through the conduit. I was about to explain to her in a superior masculine manner that it wouldn't carry the current, when the engineer said, *con expressione*, "By Jove, the girl's right," and straightway got out his pocketbook and began figuring rapidly therein.

"There," he said at last, "we'll fix the thing yet, but first, Miss Evelyn, can you tell me if there would be any chance of making a fresh connection to the switchboard at your house and of putting down one of those transformers there," pointing to a recently delivered batch of house transformers, "without your father hearing of it?"

I saw his point now, and felt inexpressibly relieved when Evelyn promised to keep the servants out of the way at the house while things were fixed up in the shed. We should have to trust to luck not to meet anyone on the way.

"You're a dear girl," said the engineer, evidently relieved, and then he unfolded his plans to us. The step-up transformer, which luckily had arrived, would transform the voltage to 2,100, and the drawing-in wire would carry nearly two amperes without risk of undue heating. As only about 1,700 watts was the maximum power that could be taken by the house, and 1,200 a strong average amount, there seemed every reason for thinking that the arrangement would work out all right in practice.

We had no time to lose now, so set to work to mount the drum on a truck, with the transformer on a board between the shafts, and Evelyn set off for the house to get things ready for its reception. We fastened one end of the wire to a tree at the side of the works, and then, no one being about, the engineer trailed the wire along the top of the parched hedge while I pulled the truck along. Although there were a great many twists in the road, there was not a break in the continuity of the hedge except for an occasional stile, a series of meadows being between the works and the house on that side of the road and a few big houses on the other. We got along splendidly till within a short distance of the house, when we found that the wire would hardly be enough, if we followed the course of the hedge, on account of the windings of the highway, so we decided to cut across the meadow to save going back for more wire. We had to wait five precious minutes, however, while a loving couple meandered down the road one behind the other, after the approved style of those in humble life whose love is too deep for words. We cursed them in our hearts as they stared foolishly at the truck and at the engineer on the other side of the hedge with a sack cast over the drum, and felt relieved when they had gone out of sight round a bend, trusting they had seen nothing incriminatory to gossip about. Then we laid the wire along the grass, propping it up with twigs as we went, though the grass itself was dry as tinder after the heat of the day. The end of the wire we threw over the side wall, as near to the shed as we could judge, and then returned to the road, the engineer to return to the works to fix up things, and I to take the transformer to the side gate, where Evelyn was waiting anxiously. By the interest she was taking in the swindle one would never have thought that she was helping to undermine her father's business, and, of course, do no good to herself financially. But then she was a woman, you know.

No one was about, so I got the transformer into the shed safely and brought the end of the wire in through a crack in the roof. Evelyn became jubilant. "I have told Henry that I've opened the switch," she said, with an unaccountable pride in the success of the lie, "so he won't come out here to-night. Can I help you?"

I did not need help to disconnect the house wires from the switchboard, twist them to the low-tension side of the transformer, and the drawing-in wire to one of its high-tension terminals, but I was rather puzzled and anxious about making a good enough earth. When, however, I told Evelyn what I wanted, she showed me the earthed end of the lightning conductor, and that job was soon over.

Before I went back to the works I wilfully wasted a couple of minutes telling her what I thought of her goodness and devotion to our cause, what my friend the engineer thought of it, and what all right-minded people would think of it if ever they got to know. In fact I should have stayed there all night babbling gratitude if she had not reminded me that the engineer might want me, and that we were not yet out of the wood.

I tore myself away and hurried back with the truck, pleased to observe that the wire was almost invisible on the hedge and calculated that it would be entirely so after dark. I found the engineer connecting a cable from one of the dynamo brushes to a choice collection of pickheads and crowbars that he had driven deep into a shallow pool at the rear of the works, and to the other brush was connected the drawing-in wire. I told him how things were situated at the house.

"Well," he said, "as long as the night keeps dry I don't think we have much to fear, but heaven help us if there is much of a dew or it rains. Mica hedges wouldn't be any good then. And another thing, if anybody goes through the hedge to-night, there'll be the other after-world to pay. Still, we must risk it now."

I agreed with him; we were so wrapped up in the affair and the hope of its successful termination, that I half believe we would have risked our immortal souls to bring this about.

The sun was well below the horizon now, so after seeing everything in order and hastily muttering a prayer to the *deus ex machina*, the machines were started.

To our joy the voltmeter finger moved around the dial as the sluice valve was opened, and with a heavy artificial resistance in circuit stood at 102. When the resistance was reduced the machine gave almost its normal output, so that we had no fear of having to overrun it and risk the armature coils. After a time the load began to come on and I went outside to see how the wire bore it. There was no apparent heating, a light breeze keeping the temperature down. Then, as the engineer had things well in hand, I took a couple of hooks and commenced an inspection of the road boxes, of which there were eleven between the house and the works. It was hard work getting off the covers single-handed; dirt had been wedged in, which, with the red lead packing and the weight of the cover itself filled in with concrete, made me appreciate the evening breeze. At nine of the boxes I could find nothing to indicate a break in the cable, and as it was now quite dark I began to fear it would have to be a hauling out job. When I tackled the tenth box, which was situated at a kind of double bend in the road close to the house, it came up very easily, nearly throwing me backward on my head. I struck a match and looked inside, and a glance explained the loose cover—and several other things eventually—for the cable had been rudely hacked asunder just where the conduit entered the box. There could be no doubt but that it was an intentional deed. The works' end of the cable hung over the hedge of the conduit, but did not touch the bottom of the box.

I sat down with my legs in the box, trying to think who had done this, but had to give the puzzle up at last, and was cogitating ruefully what a deucedly awkward thing a concentric was to splice, and how doubly deucedly awkward the operation would be if there was not enough slack to enable it to be got at properly, when I heard someone coming along the road. I did not move till I heard the footsteps stop, and then quickly retrace themselves, and when I looked up the owner of the feet had disappeared around the bend again. I thought it very strange, but concluded that it was some timid person who saw me sitting in the road and took me to be either an accident or a highwayman, and after a few minutes' meditation I got up and replaced the cover. Just as I was stamping it down, I heard a hoarse, quick cry seemingly not far off.

"My goodness," I thought, "if it's anybody messing about that hedge," and ran in the direction of the sound. There was no one in sight down the road either way, so, as the hedge was very thick, I went for the nearest stile, and looked into the field. Some little distance along, close to the hedge, I could see the form of a man lying down, and as I drew near I went sick with apprehension as I recognized the spot where the wire branched off from the hedge across the field. This, and the contracted posture of the body, made me fear the worst.

Before touching him I ascertained the whereabouts of the wire, and found that he had evidently stumbled over and beyond it in his fall. I stepped cautiously over it and turned the man on his back, realizing my morbid expectations. The man was dead! And as I bent over him I recognized the features of old Rogers.

At first I would not believe my eyes; the facial muscles had contracted, a froth had issued from the lips, and the semi-darkness may have deceived my physiognomical memory, but there was no mistaking the inevitable black bag and the massive gold chain with the cross and locket dangling therefrom. I think I may say, with some degree of truth, that the unfortunate event somewhat awed and perplexed me—perhaps because I was younger then. Why was old Rogers behind the hedge at that time of night? And what was to be done in the present state of affairs?

A dim religious light began to dawn upon me with regard to the first problem. From the position of his body, he was evidently returning to his house from the railway station. Could it be that his were the footsteps that retraced themselves at the bend of the road a short time previously, and had he then got over a stile and walked noiselessly along the field, past where I was sitting in the road, till he came in contact with the deadly wire as it left the hedge? And if so, what was the reason for this strange proceeding?

There seemed only one way to account for it; ordinary timidity did not fill the bill. A guilty conscience needs no accuser, and he had evidently recognized me sitting in the road box where the broken cable was, and had avoided meeting me. Now I saw why he had come down the road to the station in the morning flushed and heated, and had waited to cool off before seeing us; why he became so suddenly generous with the garden party tickets; and as I picked up his bag, which was securely locked, and shook it, the weight and the muffled jingle of metal inside told me plainer than a provisional specification could have done in a month that a hammer, cold chisel and perhaps some kind of appliance for lifting the lid of the road box were wrapped in newspapers inside. That settled me in my resolve to let his death remain as much of a mystery as possible, and I stepped, back across the wire and made for the works. The wire as it passed the stile had been carefully hidden out of sight and easy reach, so that there was no danger in crossing it. I passed a few people on my way back, but felt sure that no one could see the body from the road.

"Found the break?" queried the engineer, as I came panting in.

"Yes," I replied; "and the breaker."

"Good business; let's hear about it."

I sat down and explained the state of affairs. The engineer's eyes opened and his face grew longer in orthodox manner as the tale of woe proceeded. "Shall we go to the police station and give ourselves up?" I asked in conclusion.

"Not much," said the engineer, after reflection; "it's just a judgment of Providence on the man. I don't think we need say anything about it."

"Don't you think the doctors will find out the cause of his death at the post-mortem? Providence doesn't own an electricity works in Garnesdon, you know."

"We must chance that," said the engineer; besides it is very unlikely that the small current could do all that mischief. He was subject to fits or something internal, wasn't he? and probably the shock just helped one along."

I remembered Evelyn telling me that her father suffered from heart disease, so that cheered us up a little. "How rummy the place looks, lit with lamps and candles," I observed.

The engineer smiled too. "Yes, I was afraid to tinker with the circuit to-night to light us up here. By the way, the voltmeter gave an odd jump about twenty minutes ago, but I thought it was the big electrolier switch being played with. It must have been poor old Rogers giving up the ghost. I shall be glad when twelve o'clock comes and we can take that wire in out of sight," he mused. "Wonder

what the guests will think of his non-appearance, and if his plucky little daughter will guess what has happened."

I felt very sick, for Evelyn's sake. Believe me, it is never nice to discover oneself to be a murderer, and the unpleasant feeling is in no degree modified when the murdered man happens to be the father of the girl one loves. This unfortunate mental condition will prevail even when strong extenuation exists in the fact that the deceased was an electrophobian gasman.

And if Evelyn did discover how her father met his death I suppose that I should have to feel very sick for my own sake; unless, indeed, she reciprocated the affection I entertained for her to a greater extent than at the time I thought possible. These thoughts and occasional attention to the machinery helped to pass the time away.

About ten o'clock a vehicle stopped outside, and the engineer rushed to the door, unwilling that anyone should come into the station in its present condition, shut the door after him, and went to the outer gate. Some conversation ensued with the occupants of the trap, and then it was driven off. Presently he came in again.

"They've missed him at the house," he said. "The guests got tired of waiting for him to turn up, so dined with the two ladies and looked in here on their way home to see if we had heard anything of him. They fancy he must have been detained in London, but the housekeeper thinks he has had a touch of heart disease, and that's how matters stand to the outer world at present. I don't think they are likely to take any steps till the morning, and in the meantime we can get that wire out of the way."

Midnight came in due course, and we shut off. I went up the road to the house and cut the wire outside the garden wall, intending to call in on the morrow and remove all traces inside the place. As I returned, coiling the wire up, I found the engineer bending over the body, examining it.

"See where it touched him," he whispered; "just on the back of the wrist. He must have been stooping pretty low at the time, and the shock made him jump right over it. Funny-looking brown mark, isn't it?" as he struck a match to see it clearly.

We turned the body over into its original position and came away. Not a soul was out at that time of night, and we got the wire all in and went to bed worn out with the events of the day. Neither of us slept much that night, and we got up early in the morning to prepare our jointing and vulcanizing tools, expecting to hear every moment of the discovery of the body. The road was not a very much frequented one, and it was nearly nine o'clock before a man came rushing past on his way to the town. Ten minutes after, a cab containing a doctor and several policemen tore back toward the fatal spot, the loafers of the town bringing up the rear, eager to gratify that pardonable curiosity which helps to distinguish mankind from the lower animal world. We carefully inquired what was the matter before joining in the rush, but when we arrived at the scene of the tragedy the body had already been carried into the house, and the late arrivals were growling as if they had booked high-priced seats to view the spectacle. The more fortunate ones described unctuously the appearance of the body, with elaborations, and said the doctor's opinion was that deceased had had a fit on his way home from the station the night before; and though the police were at first suspicious of foul play, in consideration of the peculiar situation of the body, they eventually came to the same conclusion on finding all his valuables intact.

Nothing more would be known about it till the inquest, but so far things looked as favorably for us as could be expected.

We did not feel like going to the house that morning, so trusted to the general excitement there that the shed would not be visited, and set to work on the broken cable. Luckily, there was some slack in the drawing-in boxes on either side of the one tampered with, and, as the cable had been well greased when drawn in, we managed to haul enough along to make operations easier. People came up by dozens that day to view the spot where the body was found, which was guarded by a policeman till the coroner's jury should have seen it, and we had to rig up a tarpaulin shed to keep prying eyes from seeing too clearly the nature of our work in the box. The joint was finished that afternoon, though an experienced joiner at a shilling an hour would have probably taken a day over it.

Late in the afternoon I went to the house to proffer my sincere sympathy to Evelyn. She came down from her room on hearing who it was; her eyes red, but keeping up bravely. We only spoke about the sad bereavement at first, till, seeing that she had forgotten the operations of the night before, I inquired if I might go to the shed.

"Oh, yes," she exclaimed, her memory coming back to her. "I am so glad to say that the light was just as usual last night. Only once it seemed to go rather dull, but it was not noticed by any of the visitors. I hope you will find it all right in the shed."

I bade her good-bye for the present, and went out to the switchboard wondering what she would have said or done if she had known the cause of the light going "rather dull." The necessary disconnections were soon made, the end of the wire hauled into the shed and the transformer put in a corner ready for use, if required when the trial was over. Now that all trace of our operations had been destroyed and the circuit was in working order again, with the only man likely to destroy it out of the world, a successful ending to our endeavors seemed quite possible.

The dreaded inquest passed off very successfully—at least, from our point of view; though one of the doctors contended that lightning was the primary cause of death, heart disease supervening. No lightning, however, having been observed on the night in question, this opinion was overruled by the other doctors called in, who naturally enough preferred to attribute the effect to the most likely of doubtful causes, and the verdict was "Death from natural causes."

No one seemed to worry about the nature of the tools found in the black bag, and in due time the funeral came off and was attended by hundreds of people. All grades of sorrow were represented at the graveside—from the sorrowful sorrow of those who loved the man to the simulated sorrow of distant relations whose thoughts wandered away to the probable contents of the will—and, hypocrites though the latter were, they could have been safely given 50 points in 100 at that game by a couple of lacrymose-looking young men who were frequently convulsed by the effect of their own emotions.

After the ceremony we breathed freer, and slept at night for quite hours at a time. It was also possible for us to eat meat suppers again without being responsible for injurious effects upon the nerves of late wayfarers passing the station and of tramps who slept under neighboring hayricks.

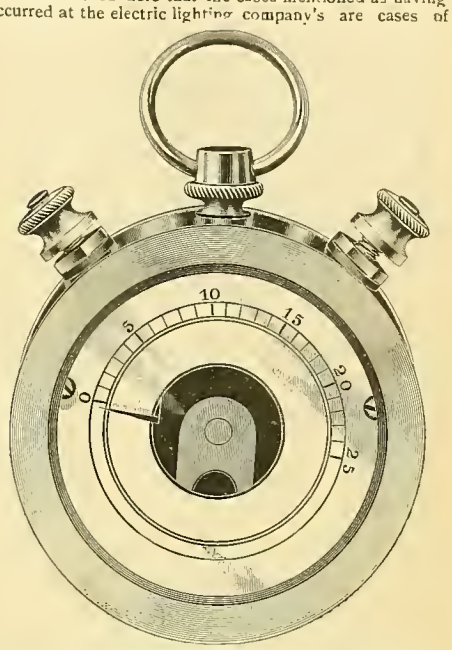
The provisional order was formally handed over to the company at the expiry of the three months' run, and now that district is one of the best lighted in the provinces. I see from the English electrical papers sent out to me that the total cost per unit is well within 3½d., so that it must be a good thing for the company at 7d. delivered. What it might have been if the late lamented chairman of the local board had caught an earlier train home on the night of his death can only be judged by his actions earlier in the day.

As I have mentioned, the engineer is dead—got drowned in the river while in charge of the works, and I am here in South America.

Oh, yes, about Evelyn—I mean Lady Fitz-something or other. She found herself left so well provided for and was so much sought after by the eligible aristocracy and needy nobility of the county, that—well, you know women, don't you?

## Metropolitan Specialties.

The Metropolitan Electric company, Chicago, is introducing a novelty in the W. E. Garey battery gauge. This instrument combines efficiency and reliability and indicates absolutely the electromotive force or actual working capacity of open circuit batteries. This gauge works by direct magnetic action; its principle of construction is an electro-magnet, with a pivoted armature so located that its axis of motion passes through one pole of the magnet and a curved portion of the armature passes through the magnetic field of the other pole. The movement of the armature is caused by the effort of the electro-magnet to shorten its magnetic circuit. The instrument is full jewelled and accurately adjusted and is a neat and desirable battery gauge for the use of telephone inspectors, electric repair men, schools and electro-medical practitioners, and from the illustration it will be seen that it can be carried in the vest pocket if desired. One pecularity of this gauge is its adaptability to use for synchronous signals; any number of instruments on the same circuit will indicate exactly the same as the one from which the signal is sent, provided, of course, that the circuits are properly wired, and while ordinary voltmeters can be used for a similar purpose, their expensive construction limits their use.




METROPOLITAN SPECIALTIES.

## Blindness from Electrical Flashes.

"As Though by a Miracle" is the head under which the New York *Sun* tells of the sudden recovery of sight experienced by James H. Caulfield after three days of total blindness. Caulfield is the Brooklyn reporter who was made blind by seeing the quick flash of a trolley wire.

Dr. Joseph M. Raub, under whose guidance the young man regained his power of vision, said that it was simply a case of hysterical blindness and nothing more. This is unique, if true. There are sure to be, however, many who will combat the theory.

At the Narragansett Electric Lighting company's works in this city, comments the *Providence Journal*, it is said that apparently similar, if not identical, cases have occurred. There are two men at the works who, during the last few years, have been temporarily blinded when throwing a switch. Superintendent Thomas says that this happens in every big electric lighting station in the country. When a switch is thrown the circuit is broken. When properly done, another connection is made simultaneously. The intense flash lasts until another connection is made. One of the men at the Narragansett company's station was so nearly blinded that he was at home three days at one time. He was not, however, as is said to have been the case with Caulfield, unable to see anything at all. He was able to grope about, but could see nothing distinctly. Both the men who have been affected at the electric lighting company's works are remarkably strong specimens of manhood, and could not be called hysterical by the widest stretch of the imagination.

In Caulfield's case, with the single exception of drooping eyelids, which might have been caused from lack of sleep, his eyes seemed to be perfect. The feature of drooping eyelids tallies exactly with the local cases cited. In fact, that seemed to be one very good reason why they couldn't see. In view of this it seems quite possible that the difficulty, in their cases at least, might be called physical rather than hypnotic, which is a term applied to the Brooklyn case by Dr. Raub.

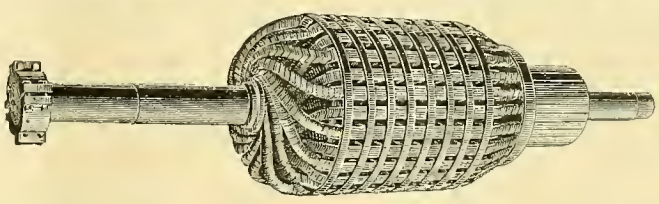
A further argument which would be advanced by those inclined to believe the theory of hysterical blindness a fanciful one is that the flash, when a switch is thrown, is far more intense than any that could come from the trolley. The switchboard at the Narragansett company's station is now so arranged that in case of a flash there is a marble slab an inch and a half thick between the man's eyes and the exact location of the most intense light. Yet Superintendent Thomas states that not later than two weeks ago he had to turn his back to the slab so powerfully dazzling was the light. If left long enough the marble slab would burn like paper.

It is believed here that the cases mentioned as having occurred at the electric lighting company's are cases of physical inability solely. There has not been the slightest indication of hysteria. If so sudden and intense a shock as must be resisted on the nervous system of these men produces no hysteria, will the theory that a trolley flash could hypnotize a person into total blindness for three days find credence?

Mr. Caulfield says that he "don't believe in hysterical blindness." There are many others who do not. But it is hard telling where physiology ends and psychology begins. It probably won't be told this century, to put it mildly; and Dr. Raub may be perfectly right.

## Rushmore Armature

The improved method of armature winding illustrated by the accompanying cut was designed by S. W. Rushmore of New York. It is intended to produce a perfectly balanced and well ventilated armature. In this winding the coils are first all cut to the required length and are placed upon the armature in equal positions while standing vertically, and are shaped upon each other in such a way that they all cross the heads in a peculiar spiral manner, so that every coil is of exactly the same shape and none of the wires cross, but gradually lap past each other. It will be seen that the coils are practically independent on the heads, and that they lay in such a manner that should the insulation become charred, there is no mechanical strain to produce a short-circuit. It will be readily understood that with the coils exposed to the air at nearly all points, an armature wound on this system will carry a much larger current with safety, and that having the coils exactly alike in shape and position on the core cannot but be an advantage, mechanically as well as electrically.

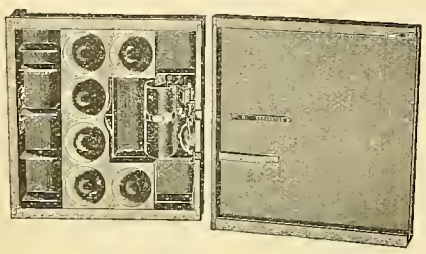


RUSHMORE ARMATURE.

Sioux City, Ia., is considering the advisability of putting in a large electric lighting plant. The contract with the Sioux City Electric company expires in August, and the light committee is of the opinion that a much better contract ought to be made. The committee has corresponded with different cities and found that a number of them are paying less per light for both gas and electricity.

## Engine and Boiler Equipment of the Metropolitan Elevated Electric Railway, Chicago.

The letting of the contract for the electrical equipment of the Metropolitan West Side Elevated Railroad company of Chicago was announced in the last issue of the WESTERN ELECTRICIAN. Since that time the contracts for the engine and boiler equipment have been awarded. The Edward P. Allis company of Milwaukee was the successful bidder for the steam engines, and will furnish four engines, two having a maximum capacity of 3,100 horse power each, and the other two a maximum capacity of 1,500 horse power each. The General Electric company's generators will be keyed to the shafts of the engines, which will be of the vertical cross compound condensing



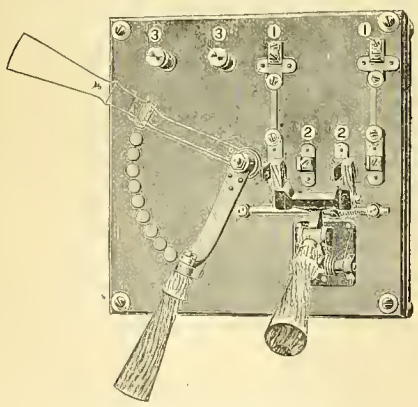
JOHNSON ELECTRIC ALARM CASH DRAWER.

type, made after a pattern lately designed by the Allis company for direct-connected work, and of which this will be the first installation. The larger engines will be run at 75 revolutions a minute, and the smaller ones at 100 revolutions. This contract was negotiated and closed by J. B. Allan, business manager of the Chicago office of the Edward P. Allis company.

To the Babcock & Wilcox company was awarded the contract for furnishing the boiler plant for the new road. This company has contracted to deliver and erect complete a battery of boilers aggregating 3 600 horse power capacity, one-half of which is to be ready for use by October 1st, the remainder to be in readiness by December 1st. This is said to be one-third of the plant which is to be ultimately installed. The boilers are all to be provided with Babcock & Wilcox automatic chain grate smokeless furnace attachments. The contract was made by the Chicago office of the company. The work upon the road construction is being rapidly pushed, with the idea of running trains if possible by this fall.

## Self-locking Starting Switch.

The accompanying illustration shows a clever device for protecting the armature of motors when the current is first thrown on. In installing motors, the switch and rheostat being generally placed side by side, and being entirely separate from each other, it oftentimes happens that through haste or carelessness the current is thrown on by the switch before the resistance is cut in by the



SELF-LOCKING STARTING SWITCH.

rheostat, and as a consequence the motor armature is burned out or the fuses blown. The W. S. Hill Electric company, Boston, Mass., has placed on the market a patent self-locking starting switch, in which the switch and rheostat are combined in such a manner that the switch cannot be thrown in without first putting in all of the resistance, thus avoiding any chance for an accident.

The General Term of the Supreme Court in Brooklyn has sustained the judgments against the railroads in these trolley suits: James Arnasen against the Brooklyn City Railroad company for $15,000; Mrs. Annie Conner against the same company for $12,500; Moses D. Kinkade against the Atlantic Avenue company for $10,000.

## Johnson Electric Alarm Cash Drawer.

The Johnson electric alarm cash drawer, manufactured by the Western Electric company, Chicago, is constructed on new ideas and has some novel and desirable features, as seen in the illustration. It consists of a cash drawer, with combination in front of five keys connected in multiple with the circuit; a bell and lock and one dry battery. The combination is easily changed, and the keys set are externally indistinguishable from those not set. If the keys set are touched the circuit is broken in the combination and the drawer may be opened without any noise, but if the proper keys are not touched the bell will ring and the door will lock if an attempt is made to open it. The drawer will lock if partially open, and while in this position the bell will ring continuously. Connection can be made to the switch and bell at any part of the building as a night alarm.

## South Side Trolley Lines, Chicago.

The chairman of the aldermanic sub-committee having in charge the proposed transformation of the auxiliary lines of the Chicago City Railway company from operation by animal power to the overhead trolley system, reports that the negotiations with the company are about concluded. The new ordinances cover the same lines as the old, taking in all the company's lines, except that part of Indiana avenue lying north of Thirty-ninth street, Clark street and Twenty-second street. The franchises are for ten years. The company is compelled to pay either $100,000 in cash at once or $10,000 for each of the ten years. Alderman Mann said that he believed the company would accept the ordinance.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, June 30.—It is rumored that there is a possibility that electricity may be substituted for steam as the motive power on the elevated railroads here. Negotiations, it is said, have been going on between the Manhattan company and the General Electric company for some time with this object in view. The decision of the Metropolitan company in Chicago to adopt electricity has doubtless had much to do with this move. As soon as the Chicago road is equipped and in running order, the system will be thoroughly investigated.

Forty or fifty relatives and friends of Isaac Liebson of Passaic, N. J., have been on guard two nights and two days to see that the Paterson, Passaic & Rutherford Electric Railroad company does not end the State street trolley war by planting poles on Liebson's property. The beginning of this trouble was referred to last week.

The Board of Electrical Control, at a recent meeting, granted permission to the Commercial Cable company to lay a subway on Battery place to connect with its cable at pier A and the proposed subway at No. 1 Broadway. The work will be done by the Department of Public Works. The Provident Loan society asked the board to give permission to the Holmes Electric Protective company to put an overhead wire on Fourth avenue, from Twentieth to Twenty-second street, so that it could get the society's protection. It appeared, however, on investigation, that the Holmes company had refused to rent space in the subway at this particular point because it had not enough business in the neighborhood to make a fair profit. The North River Electric Light company received permission to put up poles and maintain overhead wires in the vicinity of High Bridge and on 135th street, between Willis and Brook avenues. The New York Heat, Light & Power company was allowed to lay a subway in Gold street.

Electrolysis of water and gas pipes caused by the return current of the new trolley lines in Hartford, Conn., is worrying that city's board of fire underwriters, which is fearful that the fire defense may be weakened if special pains are not taken in providing for the return current. The underwriters and their electrician are reported as opposed to the system, which has been adopted by the street railway company, with the indorsement of the street board of the city, mainly because the putting in of ground plates at intervals of 500 feet to dissipate the current into the ground makes the carrying power of the rail and the bonded wires less.

The Brooklyn City Railroad company is projecting several new trolley lines. The property owners on Raymond and Navy streets have been solicited for their consent to have tracks laid on those thoroughfares between Fulton and Willoughby streets, the object of the company being to relieve the traffic on Fulton street. This new route is also contemplated: From Fulton and Sands street along Fulton to Concord, to Bridge, to Fulton, to Bond, to Hamilton avenue, where there will be a connection with the Second and Third avenue lines.

The franchises of the State Electric Light & Power company and the Kings County Electric Light & Power company, granted by the aldermen two weeks ago, became laws June 23 without the signature of Mayor Schieren.

The first official test with the searchlight before the ordnance board was made at Sandy Hook on June 27th. The Western Union Telegraph company established connection by wire with the roof of the Equitable building, where the observer received the message which was sent to him by flashes from the searchlight. The Morse telegraphic code was used. The receiver reported that he saw the signals quite plainly and after a little practice would be able to read anything sent by the flashes. The following message was transmitted:

This is the commencement of the test by the Ordnance Board, U. S. A., of the 200,000,000 candle power searchlight erected at Sandy Hook for coast defense purposes.

A partially successful attempt was made to wreck a trolley car of the Union Railway company on June 26th at West Chester. Since the trolley line from West Farms to Williamsbridge has been in operation residents of West Chester have expressed much indignation because, unlike residents of the former place, they have been obliged to pay an additional fare of five cents for the through trip. For a continuous ride from there to 129th street they have to pay ten cents, while only five cents is exacted from Williamsbridge citizens for a ride of equal if not greater length. The railway company gives as a reason for its discrimination between the two villages that the franchise issued to it by the Williamsbridge authorities contains the specific provision that the fare for a through ride shall be five cents. There is no such agreement with West Chester, and besides, there the company runs on a leased franchise from the Southern Traction company.

W. F. O.

## PERSONAL.

Prof. M. O'Dea of the University of Notre Dame is in Chicago.

Prof. H. S. Carhart of the University of Michigan is in Chicago.

George Cutter, Chicago, is in the East on a ten days' business trip.

It is stated that Prof. T. C. Mendenhall, superintendent of the coast and geodetic survey, has resigned.

Col. S. G. Booker of the Hayden-Booker Manufacturing company, St. Louis, spent a few days in Chicago last week.

Secretary D. N. McBrier of the Ball Engine company of Erie, Pa., is now in Chicago, with headquarters at 506 Rookery.

S. G. Neiler, Chicago, who has been ill for the last week, has recovered sufficiently to be at his office in the Manhattan building.

Prof. Henry A. Rowland of Johns Hopkins University will spend the summer vacation at Seal Harbor, Mount Desert Island, Maine.

W. E. Stearns has been appointed purchasing agent of the Berlin Iron Bridge company, to fill the vacancy caused by the death of William H. Riley.

One of the guests at the last "open-night" reception in the new Postal Telegraph building in New York, on June 27th, was S. F. B. Morse of Chicago.

Thomas A. Edison is reported to be recovering rapidly from his recent indisposition. As stated last week, Mr. Edison was taken ill as the seeming result of a fall.

B. J. Arnold, Chicago, will read a paper before the meeting of the Northwestern Electrical association at St. Paul, Minn., which is to be held on July 18th, 19th and 20th.

Vice-Admiral George William Preedy, who commanded the Agamemnon when it was employed in laying the first Atlantic cable, died in Devonshire, England, last month, aged 77 years.

M. d'Arsonval has been elected to fill the vacancy in the ranks of the Academie des Sciences caused by the death of M. Brown-Sequard. The nomination requires the approbation of the president of France.

## ELECTRIC LIGHTING.

Chessaning, Mich., is to have electric lights.

Ripon, Wis., has contracted for an electric lighting plant.

The Helena, Ark., Electric Light & Power company's plant was sold at auction recently by order of the court. It was purchased by the Helena Gas company, which will remodel and operate it in connection with the gas plant.

A dispatch from Grand Island, Neb., states that after July 10th, unless something new transpires in the interval, Grand Island will be without electric light. The Light & Fuel company's contract expired July 1st, and its new bid has been rejected. The council at a meeting re-

cently passed a motion that the company be notified that the city will not be responsible for lights after July 10th. The price that has been paid is $46 per month per light for 25 lights.

An English journal describes an interesting ceremony which took place at Avila, Spain, a short time ago at the opening of the electric lighting station on Sunday. At four o'clock a procession appeared, headed by the bishop of the diocese, who came down to bless the installation and open the works. The appearance of the bishop was the signal for a flight of rockets, after which the bishop walked to the boiler house, where he delivered a short prayer, and sprinkled the two Babcock & Wilcox boilers with holy water. The engines and dynamos were similarly treated, much to the dismay of the engineer. Fortunately only a few drops fell, and no harm was done. The bishop subsequently delivered an eloquent sermon on the advantages of modern science as given to the people. About 2,000 persons were present.

## ELECTRIC RAILWAYS.

The projectors of a tramway between Hirslanden and Gfüningen, in the canton of Zurich, Swizerland, have decided to adopt electric traction, with a generating station on the Forch.

The purchasers of the Maryland end of the Baltimore and Lehigh railroad, it is said, are considering plans for operating the line with electricity instead of steam. The road is being changed from narrow to standard gauge.

An extension of time for receiving bids for the proposed concession for constructing and working a system of tramways in Cairo, Egypt, and environs has been granted. The date for receiving offers has been extended to August 1st.

An electric railway 300 miles long, to cost $2,000,000, and connecting Boise City and Lewiston, Idaho, by way of White Bird, Little Salmon and the Weiser Valley, is in contemplation.

A few years ago the people of New Haven, Conn., turned out to rip up the tracks of the first trolley line. The authorities of that city are now in favor of granting a charter for an electric freight railway to traverse its thoroughfares.

A project is under consideration to build an electric road between Richfield Springs and Oneonta, N. Y., a distance of 34 miles. The estimated cost is $7 000 per mile. If built the road will carry freight as well as passengers and have six intermediate stations.

The Anglo-Austrian Bank and the firm of Siemens & Halske have submitted to the Board of Trade, says the *London Times*, a detailed plan for an underground railway in Vienna. It is intended to be an electric narrow-gauge railway, with double rails, and would begin at the Danube canal, pass under the central city to where it touches the western suburbs, continue under the Marie Lilferstrasse to the western terminus, and thence to the outskirts of the town to Schoenbrunn and Penzing. Between 17 and 18 minutes would be the time for getting from one end to the other. The railway would run directly under the pavement without touching the foundations of the houses. A single carriage, to be started at short intervals, is meant to convey 40 passengers in ordinary times, while in the morning and evening, and Sunday and fete days, two cars might be added. The bank would begin to build the underground electric railway at seven points at once and would complete it in a year from the day when the concession is granted. The Viennese, who have no means of communication in the central part of the city, wish this undertaking every success.

## MISCELLANEOUS.

The next meeting of the Western Society of Engineers will be held in the Grand Pacific Hotel, Chicago, July 11th. A paper on the "Covered Reservoir of the Rockford, Ill., Waterworks" will be presented by Charles C. Stowell, and one on "Electrolysis of Iron Pipes by the Return Current of Electric Railways," by Prof. D. C. Jackson.

It is interesting to note the observations made by E. E. Blasius and F. Swizer to show how fish are affected by a current of electricity. When the head of the fish is turned toward the anode or positive pole of a battery, calmness or even stupefaction ensues, while the fish when facing the cathode or negative pole, becomes excited, tries to evade the stimulating effect and promptly turns around in order to again enjoy the tranquilizing effect of the anode current. The curious fact was also observed that fishes, if transversely traversed by the current, always sink on the side turned toward the anode.

The governor of Virginia has received a letter from a man who advances a theory for climatic changes and the cause of diseases. The writer is amusingly interesting. He says that the extent to which electricity is being used seriously affects the atmosphere, and consequently the weather, climate and animal and vegetable life. "La grippe is caused by the action of artificial electricity upon the oxygen, giving it an allotropic character." "The use of electricity," the writer says, "has ruined the health of millions, sent tens of thousands into untimely graves, and caused the loss by fire, storm, and flood of hundreds of millions of dollars' worth of property, and, without one word of protest from press or government, is still permitted to continue its devilish work of death and destruction." The writer of the letter states that he has written a book, but has not deemed it advisable to publish it yet, but will send the governor a type-written copy if he will pay for it.

## TRADE NEWS.

The Holtzer-Cabot Electric company, Boston, has a new catalogue in press which will be sent upon application. The book illustrates the stock of this company, which devotes itself principally to manufacturing electrical specialties and dealing in dynamos and motors.

The catalogue of the Stanley Electric Manufacturing company's new two-phase machinery, described and illustrated in a recent issue of this journal, is out. It presents a fine appearance, the illustrations and presswork being of the best. The western office of the company is at 307 Dearborn street, Chicago.

The Buckeye Electric company, through its Chicago representative, J. H. Cooke, reports a steady demand for the Buckeye coiled filament lamps. Its 50 and 52 volt coiled filament lamp has proven practically successful in alternating work. The capacity of the factory at Cleveland, O., is being increased to 8,000 lamps per day.

The new boiler house for the Coe Brass Manufacturing company, Torrington, Conn., will be built by the Berlin Iron Bridge company of East Berlin, Conn. The roof of the new electric light station for the Flatbush Gas company, Flatbush, N. Y., will also be furnished by the company and covered with its patent anti-condensation corrugated iron roof covering.

The Joseph Dixon Crucible company, Jersey City, N. J., is sending to the trade an interesting record of service tests of hoisting tackle recently made by Robert Grimshaw, M. E., at the Brooklyn Navy Yard, in collaboration with Lieut. John A. Bell, of the Equipment Bureau, U. S. Navy. The tests were for the purpose of determining the percentage of power wasted by unlubricated blocks.

The Ohio Brass company of Mansfield, O., is distributing to the trade a neatly arranged price list of railway motor bearings. It includes all the different styles of bearings for the various types of railway motors, and makes a very pleasing advertisement. This company is pushing this line of material actively, and its increasing orders show that the quality of the stock and the workmanship are of the best.

A full line of main and branch cut-outs, rosettes, wall receptacles, key and keyless sockets of all systems, as well as Laclede and Hercules batteries, is illustrated in the general catalogue of the Peru Electric Manufacturing company, Peru, Ind. The company gives special attention to its porcelain department, and the articles placed on the market by the company in this line are of recognized merit. Full particulars of the process of manufacture and the designs of the different specialties are contained in this catalogue.

George L. Ferrasse, business manager of the Vandenbergh Laboratory of Chemical Industry, 31-34 Lewis block, Buffalo, N. Y., is distributing its summer calendar. Dr. F. P. Vandenbergh is consulting chemist to the Trinidad Asphalt company, and the calendar contains a photograph by him of Pitch Lake, Island of Trinidad. Attached to the laboratory is a corps of chemical engineers, analysts and consulting chemists, which will make assays and analyses, give superintendence, inspection and counsel upon subjects of chemical science.

The La Roche Electrical Works are well represented in their new catalogue, No. 4, of the series. The book is made with reference to a new plan which will doubtless prove of value. Its binding is such that should additions become desirable, brads may be removed and as many pages added as desired. The catalogue is very complete, although not attempting to cover the whole field of La Roche apparatus. In addition to illustrating some of the types of machines included under that head, diagrams explaining the La Roche system of switchboard apparatus and connections are presented. The book should be carefully read by those interested in the development of electrical machinery as well as those contemplating purchases in that line.

## BUSINESS.

The Metropolitan Electric company, Reading, Pa., is putting up a new power station and has placed the contract for the iron roof and traveling crane with the Berlin Iron Bridge company, East Berlin, Conn.

The Manhattan General Construction company, manufacturer of the Fleming wire gauze dynamo brush, has placed the Chicago agency and a stock of standard sized brushes with J. H. Cooke, 753 Monadnock building. Mr. Cooke reports numerous sales and excellent prospects for the future.

According to Manager T. C. Turlay of the Chicago Insulated Wire company, 414 Northern building, Chicago, the wire business is in a good condition. The company's factory is now busily engaged on large contracts for weatherproof, magnet and annunciator wire, and the prospects are reported as exceedingly bright.

The Edward P. Allis company of Milwaukee has closed an important contract with the Union Depot Street Railway company of St. Louis for a 1,500 horse power 36 by 48 inch single cylinder engine, to be run at 100 revolutions a minute. This engine will be similar to three of the same capacity recently ordered by the Cass Avenue & Suburban Railway company.

The Electric Heat Alarm company, with a Chicago office in the Monadnock building, has leased a factory at 145 High street in South Boston, Mass., for a term of 10 years, where it will have more than double the present floor space. The business of the company has increased considerably during the last six months, and it will move into the factory at once. The building will be fitted with all modern machinery and work first-class in every respect only will be turned out.

Edward Lasell & Co., 225 Dearborn street, Chicago, is calling attention to the line of magneto telephones which it is handling. The firm furnishes board and instrument complete, the board having a capacity as high as 500 telephones. For exchange purposes and long lines this telephone has given excellent results. It is provided with a particularly strong call bell and a transmitter and receiver of good design. The firm also handles an instrument designed for general private line use, factories, warehouses, hotels, etc.

William H. Bryan, mechanical and electrical engineer, Turner Building, St. Louis, Mo., is meeting with considerable success, judging from the list of references he has just published. Mr. Bryan is prepared to undertake professional work in the shape of consultations, examinations, estimates, tests, reports, plans, specifications, superintendence and purchasing in connection with water works, electric lighting installations, electric railway and power systems, steam and power plants, steam heating, smoke prevention, ice making and refrigeration.

President W. O. Meissner, of the Washington Electric company, 207 South Canal street, Chicago, reports good business. The Washington company is particularly busy at the present time with telephone work of all sorts. Mr. Meissner, who is an experienced and skilled mechanic, pays personal attention to the shop work and makes a point of turning out work with despatch. This should be especially appreciated by those placing contracts for telephonic fixtures, as the great complaint is that customers are unable to get work after it is ordered.

Waukegan, Ill., Talladega, Ala., Rome, Ga., Anniston, Ala., Winchester, Ind., and several other towns have recently granted franchises for telephone service. Dr. D'Unger reports that the D'Unger long distance telephone is to be used, and that on Thursday of last week the Crookston, Minn., Telephone company ordered 60 D'Unger telephones. One hundred D'Unger instruments, it is said, are to go into the exchange, the line being now in course of construction. About forty towns in Minnesota will also, it is stated, have the D'Unger instruments.

The Electric Appliance company, Chicago, states that it has been unusually successful of late in securing some contracts for the entire electrical supply equipment of several large plants for everything except the electrical machinery. The company started into the summer season without any special arrangement for a direct current fan motor, intending to devote all of its energy to the sale of the Meston alternating current outfit. A heavy demand set in, however, for a direct current fan motor and the company has succeeded in getting hold of such a desirable article in the Acme direct current fan motor, and it is now pushing it extensively.

The Ball & Wood company has again been successful in securing through its secretary and treasurer, Mr. Vincent, one of the largest power contracts which has recently been placed. The order comprises six Ball & Wood improved cross-compound condensing engines of 300 horse power capacity each for the Hartford Street Railway company of Hartford, Conn. It is this type and make of engine which has proved so economical and efficient at the Grand street station of the Consolidated Traction company in Jersey City, where the duty has been most severe and the engines subjected to almost constant overloads of from 20 to 50 per cent., pending the increase of the power plant. The factory of the Ball & Wood company has been running 24 hours per day since about June 1st, and this Hartford contract will permit no diminution of its force for some weeks.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued June 26, 1894*

521,798. Electric Arc Lamp. S P. Johnson, Schenectady, N. Y.

The invention is described as being a simple mechanism for arc lamps for use on constant current circuits. It consists of an arm or lever actuated by shunt spools, a second lever linked to the arm at one end and the other end of the second lever actuated by a series spool in combination with a clutch linked to the second lever near its center.

521,799. Electric Motor. Joseph Lee, Brooklyn, N. Y.

In the accompanying drawing is shown a side elevation and a central, vertical, longitudinal section of an electric motor constructed in accordance with and embodying the invention, which is to improve the form and construction of electric motors, to attain increased efficiency from them, and by simple and effective means to enable the speed of the armature of each motor to be independently regulated. The motor or dynamo may be described as consisting of the central frame *A*, having the interior curved electro-magnets *O P* and the removable caps *B C* fitting the opposite sides of and closing the frame, combined with the ring speed regulator *M* about equal to the width of the electro-magnets, and having the exposed switch handle *d*, the armature *L* inclosed within the regulator *M*, and the inclosed commutator and brushes.

521,800. Sound-conducting Apparatus. George A. Leech, New York, N. Y.

The invention relates to sound conducting apparatus used in the cure of deafness, and has for its object to increase the

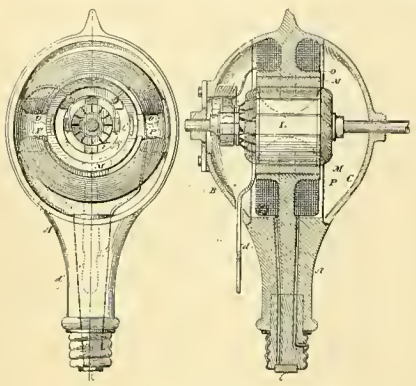
efficiency of such apparatus, and to provide means by which the electric current may be employed as an auxiliary to the inventor's system of mechanical massage.

521,808. Push Button. James F. McLaughlin, Philadelphia, Pa.

The invention is so arranged that when the push button is actuated the circuit will be closed only for a predetermined and very short time, just sufficient to actuate a distant translating device, and will then again be automatically opened, irrespective of the action or volition of the user.

521,809. Electric Lamp Lighter. James F. McLaughlin, Philadelphia, Pa.

The invention may be applied to incandescent or arc lights and to other electric translating devices which it may be desirable to start or stop from a distance without manipulating by hand the circuits which carry heavy currents. The operating mechanism is housed in the socket-holder or frame of the lamp.



NO. 521,799.

521,843. Rheostat. Burton E. Baker, Bridgeport, Conn.

The invention has for its object to produce a rheostat adapted for general use, which shall be inexpensive to produce, durable, and in which metal plates shall be wholly dispensed with. The form illustrated in the drawing is more especially adapted for use in connection with dynamos. *1* denotes the resistance wires which are wound around cores or rods *2*, which are formed from any suitable plastic material—for example, lava. *3* denotes screws which are embedded in the ends of the cores and extend outward therefrom, and *4* denotes nuts on the screws by which the ends of the resistance wires are retained in contact with the screws by being given a turn about them and clamped down upon the ends of the cores. The cores with the resistance wires wound around them are embedded in a block *5*, which is formed from any suitable plastic material, the ends of the screws extending outward from the opposite sides of the block. *6* denotes lead wires which are given a turn about the screws, and are retained in contact with them by nuts *7*, which clamp the ends of the lead wires against the sides of the block. No metal plates are required to dissipate the heat. The cores are molded to the required shape and size in the usual manner, the the screws being molded therein. After the cores have been wound with resistance wires they are embedded in block *5* while the latter is in a plastic condition, the ends of the cores extending outside of the mold. When block *5* has become set or hardened the lead wires are placed in engagement with the screws and are locked in place by nuts *7*.

521,867. Controller for Alternating Current Machines. Edmund B. V. Seaverns, Brookline, Mass.

It is the object of this invention to control the operation of alternating current machines, so that in case of a short-circuit on the circuit traversed by the alternating current the alternator may be stopped generating substantially in an instant. This is accomplished by opening the circuit traversed by the continuous current, which is preferably automatically accomplished by utilizing the extra current built up in the winding or circuit traversed by the continuous current to operate an electro-magnet governing the operation of a switch or circuit-controller, and thereby render the alternator devoid of current in its field magnets, and consequently render the generator inoperative, so that the main line circuit may be opened without danger.

521,877. Electric Arc Lamp. William J. Davy, London, England.

This invention, for improvements in electric-arc lamps, relates to focusing lamps in which the positive and negative carbon holders are connected together by a cord passing over a pulley, and in which the upper carbon holder tends to descend by gravity, and thus at the same time to draw up the lower carbon holder, so as to bring the two carbons into contact; and consists in an improved arrangement for striking and maintaining constant the arc, consisting of a gravity friction grip device acting on the cord and regulated by series and shunt solenoids.

521,891. Conduit Electric Railway. Charles J. Reed, Orange, N. J.

A conduit system of electric railways is described, utilizing a pair of electrical conductors crossing each other at stated intervals and connected to the opposite poles of an electrical generator in combination with a slitted conduit, the successive sections of the overlapping conductors lying in alignment with the slit of the conduit.

521,892. Conduit Electric Railway. Charles J. Reed, Orange, N. J.

The invention is directed particularly to improvements in electric conduit systems in which the electrical current for moving the cars is conducted through one or more buried current mains located parallel with the road-bed and insulated throughout the entire length, normally open short-branch circuits being situated at intervals, the branch circuits being connected to sectional trolley conductors located in a slitted conduit and provided with switching mechanism for connecting the sectional trolley conductors and the branches to the current main or mains, and disconnecting them in sequence as a car passes over the route.

521,906. Magnetic Separator. Henry Carmichael, Malden, Mass.

In accordance with this invention a movable or traveling carrier or support has pivotally secured to it a plurality of electro-magnets, which may be constructed to obtain a staggered effect by which the iron particles may be more thoroughly removed without agitating or disturbing the fluid pulp. Another feature of this invention consists in removing the particles magnetically affixed to the magnets preferably by hydrulic means, the electro-magnets at such a time being automatically cut out of the electric circuit to enable the particles to be more easily washed from the magnets into a suitable receptacle.

521,908. Automatic Safety Joint for Electric Wires. James H. Curry, Wilkinsburg, Pa.

It is the principal object of this invention to provide a safety joint to prevent accidents in case live electric wires become broken or detached and fall in the street, in which case the break in the wire is made to automatically cut off the current from the ends of the wire and render it harmless. Its construction, in position for giving continuity of the current, and when the line is broken, may be seen by reference to the drawing. Its operations is as follows: The box *A* being suitably suspended by the cross-trees or wires from the pole, the line wire sections *i i* are put up under tension with the seats *e e'* of the arms *B B'* resting against the pins *d d'*, and with the upper ends of the elbows *C C'* bearing tightly or positively against the bridge springs *a b*. In this position as long as tension is maintained on the line wires *i i*, the seats *e e'* of the pins are tightly held against the pins *d d'*, and the two elbows are electrically connected by the bridge springs *a b*. Consequently the current can freely and continuously pass over the line to the trolley, which bears against and rolls along the lower edge of the wires *i* and arms *B B'*. When, however, from any cause, the line wire bearing the electric current breaks and drops down into range of pedestrians or teams, one of the arms drops down by reason of the slot in its elbow, and in this movement the elbow *C* leaves the conducting bridge spring *a b*, thus breaking the circuit at this point, while this arm is prevented from moving into electrical contact with *B'* by the interposed non-conducting block *c*. It will thus be seen that no matter where a break occurs in the line wire the arms *B*, which connect with this broken section on each side of the break, drop down and both ends of the line wire which hang down are instantly and automatically cut out of circuit and rendered harmless to pedestrians and teams in the street below.

521 914. Electric Soldering Tool. James F. McLaughlin, Philadelphia, Pa.

It is the object of the invention to render electric soldering efficient for practical use, with all of the parts accessible for inspection and repair.

521,924. Transformer Electric Lighting System. Peter Wright, Philadelphia, Pa.

The objects of the invention are to provide for the simple, automatic and practical interruption of a primary circuit subsequent to the interruption of a secondary circuit; to provide compact, simple and reliable mechanical and electrical means for controlling the interruption of the primary and secondary circuits in such manner that the secondary circuit is broken before the primary circuit, and to provide compact, durable and efficient switch mechanism and connections for controlling the secondary circuit, and also the local circuit and its mechanical devices that operate to make and break the primary circuit..

521,925. Transformer System of Electrical Distribution. Peter Wright, Philadelphia, Pa.

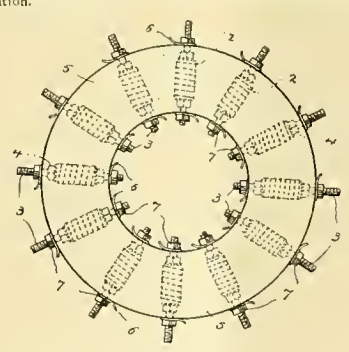
The objects of this invention are to provide several transformers that are automatically called upon to energize a secondary circuit or are automatically cut out therefrom according as the latter is called upon to do more or less work; to construct and arrange these several transformers in such a manner that they are automatically cut into or out of action by the increase or decrease of current due to an increase or decrease of work required of the secondary circuit, and to prevent short-circuiting the secondary circuit of one transformer through the secondary circuit or secondary coils of the other by closing the primary circuit of all additional transformers before closing their secondary circuits, and by opening their secondary circuits before opening their primary circuits, whereby the liability of the occurrence of a destructive spark is reduced because there is always a closed circuit through one transformer.

521 936 Electric Arc Lamp. Louis B. Marks, New York, N. Y.

The invention consists in forming a check in the chamber of what is known as an incandescent arc lamp against the entrance of air by providing the inclosure with an opening in which any inflowing air will be met by a body of gaseous products of the arc which will tend to dam it off, and by admixture therewith will dilute it.

521 952. Adjustable Carrier for Electric Lamps. Robert Faries, Decatur, Ill.

The invention relates in part to an extensible hanger, in part to a swinging arm and in part to the hanger and arm in combination.



NO. 521 843.

521,970. Accumulator Plate. Charles J. Barbier, Lyons, France.

The invention consists in an improved construction of accumulator plates, the object of which is to prevent absolutely the dropping off or the deformation of the active matter, and to increase the power by gathering the current at points very near the one to the other in the inner part itself of the matter.

521,976. Thickness Gauge for Paper Making Machines. Otto W. T. Amende, Bad Harzburg, Germany.

The apparatus is connected by an insulated metal wire with an electric battery and bell, while a second wire leading to the electric bell is fastened directly to the apparatus; the bell is actuated at any desired moment determined by the apparatus, apprising the workmen that the prescribed thickness of the pulp or the paper has been reached.

522,022. Thermal Alarm. Hosea F. Maxim, Norfolk, Va.

The object of this invention is to provide a simple compact device which can be utilized to indicate visibly or audibly, preferably the latter, when the heat in an apartment reaches either or both of at least two predetermined points.

522,029. Electric Time Signaling System and Apparatus. Walter A. Purcell, Newark, N. J.

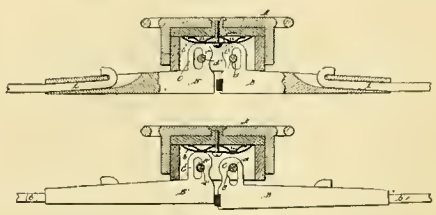
This invention has for its object the electrical transmission of signals for indicating time, such signals being transmitted from a central station or point to an indefinite number of sub-stations or points, the central station or point being provided with an automatic time switch device controlled by a clock and electric transmitting apparatus, and the sub-stations being provided with a bell or other receiving instrument, and a circuit controller whereby the bell or other receiving instrument will announce the time, giving the hour and minute at any given station.

522,097. Electrically Operated Adding Machine. Robert Baumann, St. Louis, Mo.

The invention is an improved electrically operated adding machine, the result of whose operation may be ascertained by a glance at a sight opening.

522,051. Brush Holder for Dynamo-electric Machines. Rodolphus Fuller, Detroit, Mich.

The invention consists in the peculiar construction of a brush holder having a spring for forcing the brush into contact with the commutator, with means for maintaining a constant pressure in the spring at all times, regardless of the length of the brush, and, further, in the peculiar construction of the means employed in securing the brush holder to the yoke or frame and for adjusting it.



NO. 521,908.

522,052 Commutator. John C. Fyfe, Chicago, Ill.

Primarily the object of the invention is to provide improved means for assembling the segments or sections, and to provide a durable and effective method of retaining the segments by as few parts as possible, and for properly insulating the several parts. A further object is to so construct the segments that they may be readily replaced without the destruction and loss of the whole commutator.

522,055. Circuit Maker. Daniel F. Hall, Schenectady, N. Y.

The invention relates to electric fire alarms or annunciators, or more particularly a device for forming a battery to generate the necessary electricity to actuate the annunciators in case of an emergency.

522,057. Trolley Stand. Eleazer F. A. Heastings, Avalon, Pa.

The invention is adapted to hold a trolley pole in such a way that the trolley wheel is always pressed against the wire, which is sufficiently flexible, however, that the wheel easily follows the wire through its different elevations.

522,067. Means for Suspending Electric Motors from Cars. Robert Luodell, Brooklyn, N. Y.

The inventor utilizes in part the combination in a car or vehicle having a single propeling motor yieldingly sustained beneath its frame, and the rotary part thereof connected at its opposite ends through sprocket wheels, of sprocket chains to shafting, which in turn is geared through speed-reducing gearing to two of the axles thereof, in combination with a sliding support for the motor and means for compensating for undue stretching of the sprocket chains.

522,083. Dynamo or Magneto-electric Machine. Leonard Paget, New York, N. Y.

The inventor describes as part of his invention a magneto or dynamo electric machine, having a rotary part with projecting pole pieces in combination with a fixed or stationary part having corresponding projecting pole pieces and a single coil wound about the fixed or stationary part.

522,113. Electrically Operated Register. Sheldon J. Glass, Milwaukee, Wis.

The invention relates particularly to that class of registers employed for counting the movements of a reciprocating, oscillating or rotary device, and registers of this class are employed to automatically count certain manufactured articles as they are successively produced.

522,127. Voltaic Battery. Henry Timm, New York, N. Y.

This invention consists in a voltaic couple which is formed of a dry layer of a soluble electrolyte inclosed between two layers of an absorbent material and two metallic plates of different polarity, one of which is in close contact with the opposite faces of the absorbent layers inclosing the soluble electrolyte and protected from contact with the second metallic plate by two absorbent layers, with the outer faces of which the second metallic plates are in close contact.

522,151. Method of Heating Metals Electrically. Charles L. Coffin, Detroit, Mich.

The invention consists in heating the metal, connecting it with one terminal of a generator of electricity, bringing it in contact with a liquid electrode connected with the other terminal of the generator, and establishing a voltaic arc between the two electrodes. It also consists in heating the metal previous to its immersion in a liquid electrode, connected to one terminal of a source of electric energy, the metal being connected to the other terminal of the source of electric energy, and establishing a voltaic arc between the electrodes.

522,175. Insulator. Johan M. Anderson, Boston, Mass.

The insulator described is especially designed to be used as a support for the feed wires of the overhead system of electric railways.

522,180. Trolley Wire Hanger. Thomas J. McTighe, New York, N. Y.

The invention consists of a stud formed on the line fixture externally threaded, and having a central slot with curved bottom in combination with a flat plug or follower fitting in the slot and having its lower end substantially conforming to the curved bottom of the slot and forcibly held therein by a cap screwed on the stud, the trolley wire being laid in the slot and forced into a bend by the plug and cap.

11 423. Electric Burglar Alarm. Alfred Stromberg, Chicago, Ill.

The invention relates to electrical burglar alarms, and more particularly to that class in which a central office is equipped with apparatus adapted to give an alarm when the district circuit is opened. Its object is by an arrangement and construction of circuits to protect the system against interference and to insure the reliability of the alarm.

# Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, JULY 14, 1894. No. 2


## The Great World's Fair Fire.

Electricity building at Jackson Park is nothing but a desolate heap of twisted iron, charred wood and broken staff. To a large proportion of the readers of this journal the news of the great fire of the 5th instant must have come as something in the nature of a personal affliction. The building had served its purpose, to be sure, and would have been torn down within a year at best, but nevertheless the contrast between the stately edifice of a year ago, with its animation and brilliance, and the ash-strewn site of to-day is so great that the realization of the fact carries with it a pang—a feeling of regret that the handsome building that marked the first distinct recognition of electricity in international expositions should be so rudely swept away. Yet the ending was dramatic; electricity building went down with its fellows about the Court of Honor in a burst of fiery splendor that was perhaps, after all, the most fitting termination of the existence of the grand and beautiful structures which were the glory of the World's Fair.

The fire originated in the terminal station a few minutes after six o'clock in the evening on Thursday of last week. It quickly spread to the administration building, and thence to the buildings on either side. Before midnight the list of large buildings that had been completely destroyed embraced the administration, mining, electricity, manufactures and agricultural buildings, machinery hall and the terminal station, as well as several bridges and small buildings and the Casino pier. The fire department was slow in responding to the alarm, and after the conflagration was fairly under way could do little except to prevent the flames from spreading beyond the grounds. Fortunately for this purpose the wind was from the west, although this fact rendered the total destruction of the buildings about the grand basin more certain. When the fire was at its height the scene was one of indescribable grandeur, and many thousand spectators were attracted to the park by the tremendous billows of smoke illumined by the great glow beneath. The South Side lines of transportation made special efforts to carry the throng, and several persons were injured by being thrown or pushed from the crowded cars. Considering the magnitude of the fire, the loss was not great, and fell principally upon the salvage company which had purchased the buildings for the material contained in them. In the electricity building this company had placed for sale many pieces of sculpture removed from other buildings and portions of the grounds, and this collection was, of course, a total loss. As far as can be ascertained, the only electrical apparatus destroyed was in the old charging station of the Electric Launch & Navigation company just south of the agricultural building. Several electric launches that still remained undisposed of were towed out in safety, but a considerable quantity of apparatus, consisting of switches, rheostats, measuring instruments, wire and batteries, was destroyed.

The illustration presented on this page shows the electricity and mining buildings in flames, and is a reproduction of a photograph taken about 7:30 P. M. The ruins of electricity building are shown on page 15, and the picture gives a good idea of the complete devastation wrought by the fire. The iron trusses seen dimly in the background through the smoke of the still smouldering embers are those of machinery hall, which, it is scarcely necessary to say, was of especial interest to the electrical fraternity last year, sheltering, as it did, the great central station plant of 18,000 horse power. For purposes of comparison, interior and exterior views of electricity building, as it appeared in its pride, are presented on page 14.

As intimated above, the electricity building was the first structure of the kind to be erected for a general international exhibition. It was 695 feet long and 345 feet wide, and cost about $285,000. The architecture carried out the Spanish renaissance idea, modified by a Corinthian treatment. The general scheme of the plan was based upon a longitudinal nave 115 feet wide and 114 feet high, crossed in the middle by a transept of the same width and height. The exterior walls were composed of a continuous Corinthian order of pilasters three feet six inches wide and 42 feet high, supporting a full entablature and resting upon a stylobate of eight feet six inches. The total height of the walls from the grade outside was 68 feet six inches. At each of the four corners of the building was a pavilion, above which rose an open tower 150 feet high. The building had an open portico along the whole of the south facade, the lower or Ionic order forming an open screen in front of it. The various subordinate pavilions were treated with windows and balconies. The details of the exterior were richly decorated, and the pediments, friezes, panels and spandrels received a decoration of figures in relief, the

THE BURNING OF ELECTRICITY BUILDING, JACKSON PARK, CHICAGO.

general tendency of which is to illustrate the purposes of the building. In the hemicycle on the south front stood the fine statue of Franklin, by Rohl-Smith, now in Philadelphia. The appearance of the exterior was that of marble, but the walls of the hemicycle and of the various porticoes and loggias were enriched with color, the pilasters in these places being decorated with scagliola, and the capitals with metallic effects in bronze. The building, with its large window spaces and high central and corner towers, was especially designed for electrical illumination by night, although this feature was not carried out to the extent intended.

## Electrical Banquet in London.

On June 15th Sir David Salomons and the directors of the City of London Electric Lighting company invited a number of the members of the technical and newspaper press, several scientific men, a few of the leading lights of the electrical industries and the lord mayor of London, to a banquet at Cannon Street Hotel, where everything had been cooked by electricity. There were in all about 100 guests, who were, before the dinner, invited to inspect the process of cooking. In the kitchen, which was a carpeted room adjoining the reception room, were placed some five or six electric ovens raised above the floor on tables, and on an adjoining table were electric hot plates, electric saucepans, electric fish kettles and other culinary necessities. There was no combustion, the heat being generated in resistances placed in enamel on the sides, top and bottom of the ovens. Each side, together with the top and bottom, was separately regulated by a switch placed at one side of the oven. The dinner was an entire success and proved both instructive and entertaining.

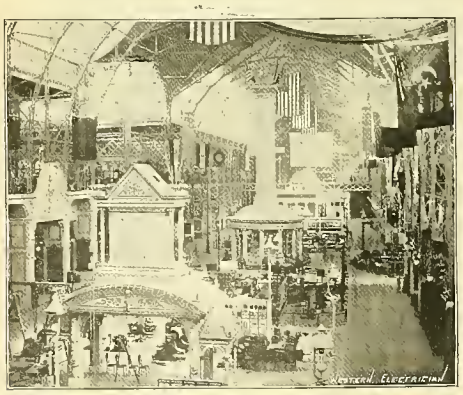
In considering the subject of electrical cooking it may be remembered that the idea is not new, as Prof. S. P. Thompson shows by the following extract from a letter written by Benjamin Franklin in 1749:

Chagrined a little that we have hitherto been able to produce nothing in this way of use to mankind, and the hot weather coming on, when electrical experiments are not so agreeable, 'tis proposed to put an end to them for this season, somewhat humorously, in a party of pleasure on the banks of Skuylkill. Spirits, at the same time, are to be fired by a spark sent from side to side through the river, without any other conductor than the water, an experiment which we some time since performed, to the amazement of many. A turkey to be killed for our dinner by the electrical shock and roasted by the electrical jack, before a fire kindled by the electrified bottle, when the health of all the famous electricians in England, Holland, France and Germany are to be drank in electrical bumpers, under the discharge of guns from the electrical battery.

## Measurement of the Resistance of Electrolytes[1].

By F. J. A. McKittrick.

During the present session at Dalhousie College, I wished to make a series of experiments, determining the electrical resistance of certain electrolytes. Not having the apparatus necessary for Kohlrausch's method at my disposal, I employed that used by Ewing and MacGregor (Trans. R. S. Edin., Vol. XXVII. (1873), p. 51), which, according to the tests applied to it by Prof. MacGregor (Trans. R. S. Can., Vol. VIII. (1890), Sec. III., p. 49),



INTERIOR OF BURNED ELECTRICITY BUILDING.

seemed capable of giving results sufficiently accurate for my purpose.

Since this method, for its most successful application, especially if used in the way suggested by Prof. MacGregor in the latter of these two papers, requires some training of the eye in observing the motions of a spot of light, I undertook a series of preliminary experiments. In the course of these experiments, certain improvements suggested themselves to me. These improvements and their effect on the working of the method, this paper attempts to point out.

As the method has been fully described by Prof. MacGregor in the paper already referred to, I need but give a short sketch of it here. The electrolytic conductor is introduced by platinum electrodes as one of the arms of Wheatstone's bridge, and the process of determining its resistance is the same as in the case of a metallic conductor, viz., by a gradual adjustment of the arms. The indications of the galvanometer, however, will not be the same as in that case, owing to the fact that the electrodes become polarized through the passage of the current. The effect of this polarization on the galvanometer is the same as if, during the passage of the current, the resistance of the electrolytic cell gradually increased.

Imagine the arms of the bridge so adjusted that, on the passage of the current, the light spot of the galvanometer moves off to the right and remains there, such a deflection having been ascertained to mean that the resistance being measured, if metallic, was too small to give zero deflection. If we gradually change the adjustment of the arms in such a way as to diminish this deflection to the right, it will not be found possible to obtain an adjustment making the deflection zero, but an adjustment will be reached with which the light spot moves first to the right, stops, moves back and off to the left, showing that though at the beginning of the flow of the current, the resistance of the cell was small enough to give a deflection to the right, it has been virtually increased by the polarization until it is so large as to give a deflection to the left. We have thus a double deflection. As we continue changing the adjustment so as to diminish the initial deflection to the right, the double deflection will grow less and less until finally we shall have only the deflection to the left.

If we had a magnet and mirror of indefinitely small moment of inertia, hung by a fibre offering no resistance to torsion, so that it would, at any instant, indicate the direction of the current flowing through it, this double deflection would only just vanish when the adjustment of the arms indicated the exact resistance of the cell, that is, when the resistance of the cell, calculated in the ordinary way from the resistances in the other arms, would be its exact resistance.

With an actual mirror and magnet of finite moment of inertia, no appreciable motion can be observed till the current has acted for some time. If the adjustment of the arms be such as to indicate a resistance for the cell only slightly greater than its real value, the first current flowing through the galvanometer will be very weak, and, before it will have time to produce an appreciable deflection of the mirror, the electrodes will have become polarized, and our only deflection will be one to the left. If, then, we take the resistance of the cell to be that indicated when the double deflection has just vanished, we make an error, and conclude the resistance to be greater than it really is. Whether, with any magnet and mirror yet manufactured, this error can be made small enough to be neglected, can be determined only by experiment.

In their experiments, Ewing and MacGregor assumed that the light mirror and magnets of Lord Kelvin's deadbeat galvanometer would give a close approximation to accurate results. In order to reduce polarization, they used as current generator only one Grove cell, and introduced large resistance into the arms of the bridge. Their determinations, however, when compared with those given by more elaborate and accurate methods, were found to be too large, differing from Kohlrausch's, in some cases, by as much as 12 per cent.

As their experiments were made when they were students and had acquired little experience in experimental work, the discrepancy may have been due to other causes than the defects of the method. Hence Prof. MacGregor, in order to test the method, made a series of experiments, decribed in the paper cited, comparing the resistance of solutions of zinc sulphate as given by this method and by the use of non-polarizable electrodes. To reduce polarization, he also used weak currents and, in addition, electrodes of large area. He found that, if the mere vanishing of the double deflection were taken as the test of adjustment, the resistances determined would be too much greater than their real values to be regarded as a sufficiently close approximation. He noticed, however, that when he could no longer observe a double deflection, he yet could notice a distinct hesitation at the beginning of the single deflection. That this should be so is evident. For, after the double deflection has just vanished, the first current passing through the galvanometer still tends to cause a deflection to the right, but is overpowered by the polarization current. Hence the mirror does not begin to move as soon as contact is made but, for a short time, remains at rest. Clearly then, if the adjustment of the arms be changed until we can observe not only no double deflection, but also no hesitation, we shall get more nearly accurate results. By observing the vanishing of the hesitation, Prof. MacGregor was able to get results which, in the case of high resistance, differed from their true values only by from 0.1 to 0.4 per cent.

I began, therefore, by endeavoring to observe the vanishing of this hesitation, testing my results in the same way as Prof. MacGregor had done in the paper already cited.

The electrolytic cell which I used consisted of strips of window glass cemented together with marine glue. Its length was about 16 centimeters, breadth 8 centimeters, depth 9 centimeters. It was divided transversely into two equal compartments by a glass partition cemented in so as to be water tight. Passing through the center of this partition, and cemented at right angles to it, was a glass tube with its ends open. Its length was one centimeter, the diameter of its bore 0.3 centimeter. At each end of the box I placed my platinum or amalgamated zinc electrodes, as the case might be. They were each about 7 centimeters square and had narrow strips projecting above the box. To these strips of the zinc electrodes thick copper wires had been soldered without the use of acid; to the platinum electrodes, thick platinum wires had been welded. By these wires the cell could be joined up as an arm of the bridge.

The electrodes were, in all cases, placed as close as possible to the ends of the box. Since, however, the resistance of the column of liquid in the tube was about 1,000 times that of a cross section. 1 centimeter in length of the liquid in the box, slight differences in placing the electrodes made no appreciable difference in the resistance of the box.

The part of the box above the surface of the liquid (especially that of the glass partition) was kept clean and dry, and, during the experiments, except where the narrow strips of the electrodes projected upward, the box was kept covered.

With this cell it was the same liquid, whose resistance was measured whether the platinum or zinc electrodes were used, and the tube being in the centre of a large mass of liquid, that liquid being approximately at the temperature

THE BURNED ELECTRICITY BUILDING.

of the laboratory, and the time intervening between two measurements, one by platinum the other by zinc electrodes, being small, any change in the resistance due to change in temperature might be neglected.

The box of resistance coils used was a small one. The coils were arranged so as to form three arms of a Wheatstone bridge. Two of them contained two coils each, 10 and 100 Siemens units respectively. The third contained a number of coils ranging from 500 to 1 Siemens units, together with a rheochord for measuring fractions of a unit. The coils had been accurately calibrated in legal ohms by White of Glasgow.

The galvanometer used was a dead beat one of Lord Kelvin's, having a resistance of 500 ohms. The mirror, with magnets attached, weighed 0.035 gramme.

For making and breaking contact I used a "rocker," like that described by Ewing and MacGregor in the paper already referred to. It was so designed that the battery wire was joined up a small fraction of a second before that of the galvanometer.

I found that I was unable with any certainty to detect the vanishing of the hesitation. To my eye it did not seem to vanish even when the adjustment of the arms indicated less than the actual resistance of the cell. The motions of the magnet certainly became quicker then, but none the less did I think I could detect a hesitation. Nor is this other than we would expect. The current must always act for a certain time before any appreciable motion of the mirror occurs. The length of this time will vary with the strength of the current. With a weak current the magnet always starts slowly, while with a strong current it may seem to start almost instantaneously. With a certain current and a certain resistance of our cell, there will be a particular hesitation corresponding to the adjustment of the arms indicating the exact resistance of the cell. With considerable practice we may train the eye to recognize this particular hesitation, so that, within a short range of this resistance of the cell, we may be able to make almost perfect measurements. This was the only way in which I was able to use Prof. MacGregor's method and the result was unsatisfactory. For when the resistance of the cell was changed to any extent, the strength of the current changed and I found that my familiar hesitation was no longer that which corresponded to the adjustment of the arms indicating the resistance of the cell.

In my experiments I noticed, however, what is clearly evident, that the stronger the currents, the greater was my double deflection, that if for certain resistances of the arms with a certain current I could get a double deflection, then with a stronger current I would get a larger deflection, and, what to me was more important if, in the former case, the double deflection had just vanished, in the latter case it was distinctly visible. I immediately tried still stronger currents and found that in every case the stronger the current the nearer would the adjustment of the arms, when the double deflection had just vanished, indicate the true resistance of the cell. It appeared, therefore, that I had merely to increase the strength of the current to make my error as small as I pleased.

In attempting this, however, difficulties arose:

(1.) As the battery current was increased, so was the polarization current. To lessen this my electrodes were made as large as possible. As I have already said they were about 7 centimeters square. I might have platinized them, after the manner of Kohlrausch; but as the method under consideration, owing to the simplicity of apparatus required, is especially useful for measuring resistances of electrolytes in ordinary laboratory work, I was more interested in knowing what degree of accuracy was attainable by it with apparatus which is always at hand.

(2) Since the motions of the mirror are indicated by those of the spot of light reflected from it to a screen, in proportion as the double deflection gets smaller and smaller, the difficulty in observing it gets

1. Novia Scotian Institute of Science.

greater and greater. Especially is this so if the current be strong, for then the motions of the spot become so rapid that, unless the double deflection is distinctly made, we are not able to observe it. This difficulty I completely removed by placing a rectangular sheet of zinc three or four inches in front of, and hiding from my eye, the left side of the screen. It was easy to place this so that on looking past its right edge I could just see the faintest glimmer of the spot of light. Since I always sent the current in such a direction that the double deflection was to the right, it is evident that even the least tremble of the spot to the right could be at once observed. More especially was this so, as the sheet of zinc was much nearer to the spot of light than to my eye. It is necessary, of course, that the edge of the spot of light that we are observing should be very clearly defined, and that no motion of the head should be made at the instant of observation.

(3.) With strong currents electrolysis of the solution goes on at a rapid rate, and, again, there is danger of the coils becoming heated. During the final measurements, then, when we are using the strongest currents, contact in the battery wire must last only for a small fraction of a second. The "rocker," thus, became too slow a means of making and breaking contact. By joining up the galvanometer first and by a separate key (a method to be justified later) the solution of this difficulty became easy, for then we have only to make and break contact rapidly in the one wire. This I accomplished by slightly flattening a piece of thick copper wire, and sinking it into a board till its flattened surface was only slightly above that of the board. This wire I connected with one of the battery wires. The end of the other battery wire I flattened, and by simply drawing it over the board and across the wire, contact could be made and broken as rapidly as desired.

I found it quite impossible, as did Ewing and MacGregor, and Prof. MacGregor, to obtain platinum electrodes which, in themselves, did not constitute a voltaic cell. In every case my electrolytic cell was found to be a voltaic cell with a small and, apart from polarization, practically constant electromotive force. It is evident that with this method the adjustment of the arms which would give no double deflection, would not be exactly the same as if the electrolytic cell were not behaving as a voltaic cell.

Both Ewing and MacGregor, and Prof. MacGregor overcame this difficulty in this way. Call $e$ the electromotive force of the cell. Pass a current through the cell in such a direction as to produce a polarization current greater than, and opposite in direction to, that produced by $e$. Then as this polarization slowly dies away, there will be a short time during which it will neutralize $e$. During that time they considered that the test could be made without error due to $e$.

To this procedure there are objections. In order to produce the necessary polarization so that it will die away slowly, the current must pass for a certain time, and thus a certain amount of electrolysis goes on—the more, the stronger the current. Then there is the great difficulty in making the test at the instant at which $e$ is exactly neutralized. In my very many trials, I am not certain that I succeeded in making one test with which I was perfectly satisfied. In any case we do not entirely eliminate error due to $e$. For we have naturalized $e$ only by covering our electrodes with gas, which must make the resistance of our cell appear greater than it really is. Since, however, $e$ can always be made very small, this error is, in practice, negligible.

In his paper, Prof. MacGregor pointed out one result of which he made no use, but which suggested to me an easier solution of this difficulty. What he showed was, in effect, that if the galvanometer wire be joined up first and the spot of light be allowed to take up a new position due to $e$, and if the adjustment of the arms corresponds to the exact resistance of the cell, then, on making contact in the battery wire, the current through the galvanometer due to $e$ will remain unaltered. It seems reasonable to suppose therefore that, if the adjustment of the arms nearly corresponds to the exact resistance of the cell, and if $e$ be very small, then, under these circumstances, any change in the current due to $e$ flowing through the galvanometer, which occurs when contact is made in the battery wire, will be very small. If then we should join up the galvanometer wire first and make our measurements as if $e$ had the value zero, would the error be negligible?

To test this, I simply made several measurements, first by this method, and then by neutralizing $e$. I varied both the size and the direction of $e$, but, in no case was I able to notice any difference in the two measurements.

To proceed in this way, however, the galvanometer must be joined up first. Rigorously this will not give accurate results; for the principle on which measurement of resistances by a Wheatstone bridge rests, requires that the current shall have attained a steady value. Whether, practically, with circuits such as I was using, any error would be introduced by this method, could be decided only by experiment. To test this, I simply measured the resistance of a solution of zinc sulphate, using amalgamated zinc electrodes, first joining up the battery wire before the galvanometer wire, and then *vice versa*. The experiments that I made perfectly satisfied me that the error, if there was one at all, was clearly negligible.

During my experiments the resistance of my cell varied from 100 to 10,000 legal ohms. The accuracy with which I could determine the resistance is shown in the following table, which gives a few average results:

| No. of Grove's Cells used. | RESISTANCE AS DETERMINED BY | | Error. |
|---|---|---|---|
| | Amal. Zn. Electrodes. | Pt. Electrodes. | |
| 1. | 6360 Legal Ohms. | 6430 Legal Ohms. | 1.1 % |
| 2. | 6360 " | 6420 " | .94 % |
| 3. | 6360 " | 6407 " | .74 % |
| 8. of low internal resistance. | 177.3 Legal Ohms. | 178.2 Legal Ohms. | .51 % |
| " | 634.9 " | 637.8 " | .46 % |
| " | 1893 " | 1900 " | .37 % |
| " | 4585 " | 4595 " | .22 % |
| " | 7439 " | 7450 " | .15 % |
| " | 9139 " | 9151 " | .13 % |

Prof. MacGregor's error in the measurements of high resistances varied from 0.1 to 0.4 per cent. With low resistances, however, his error was as great as 6 or 7 per cent. The first three entries of the foregoing table show then, that, with a comparatively weak battery as current generator, the errors in the resistances determined by employing the vanishing of the double deflection as test of adjustment, are comparatively large, considerably larger than they would be according to Prof. MacGregor's experience, if the vanishing of the hesitation were taken as the test. The last seven show that, with a strong current, the employment of the vanishing of the double deflection as test of adjustment gives results which, in the case of high resistances, are considerably more accurate, and in the case of low resistances very much more accurate than those given by a weak battery with the vanishing of the hesitation as test.

It would thus appear that these modifications render this method capable of measuring all resistances with increased accuracy and low resistances with greatly increased accuracy, while they render it also capable of application without any previous training of the eye, and diminish very materially the time required for its application. The error in the measurement of high resistances is still greater than that of Kohlrausch's method, viz., 0.05 per cent. The only mirror, however, which was available for my experiments, though it weighed but 0.035 grammes, was much heavier than some which I believe are now manufactured. With a lighter mirror the inevitable error would doubtless be still further diminished.

RUINS OF THE BURNED ELECTRICITY BUILDING, JACKSON PARK.

## Oil Fuel at the World's Fair.

Oil fuel at the World's Fair is the subject of a recent report by Charles F. Foster, the mechanical engineer of the exposition, to the Standard Oil company. During the period of the exhibition the main boiler plant consumed 10,614,401 gallons, or 74,300,805 pounds of oil for generating steam, developing the aggregate energy of 32,315,964 horse-power hours, at a cost of 6.3 mills per horse-power hour. The contract price for the oil delivered in the exhibition tanks was 72½ cents per barrel of 42 United States standard gallons. The boiler house force and equipment comprised 210 burners, atomizing oil beneath 52 boilers, with a standard rating of about 21,000 horse power, and attended by a staff of 42 men, divided into three eight-hour shifts. An equivalent consumption of from 500 to 600 tons of coal per day would have been necessary, so that for the duration of the exhibition 70,000 tons of coal would have been needed. Mr. Foster remarks: "It would be difficult to imagine how this vast amount of coal would, in the limited space available, have been handled expeditiously and without endangering life and property. The saving to the exhibition by the use of oil fuel was about 27 per cent. as compared with the estimated cost of coal, including the labor of handling. The oil plant worked from start to finish without a break; and the smokelessness and absence of odor from the chimneys of the boiler house were subject of general comment."

It is said to be the intention of the new company, which will shortly begin the construction of an electric road from Council Bluffs, Ia., to Manawa, when its line is completed, to place on Manawa Lake a line of electric launches similar to those used on the lagoon and lakes about the World's Fair grounds. Power will be secured from the plant of the company and will be stored in storage batteries.

## The Most Economical Life and Efficiency of Incandescent Lamps.[1]

By W. L. Abbott.

Before entering into the discussion of this subject it should be stated that the data here used relating to the variation in the condition of incandescent lamps under various pressures are taken from published accounts of tests made by various parties, which are, from the closeness

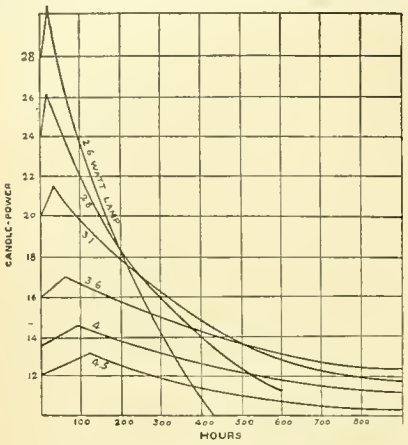



FIG. 1. MOST ECONOMICAL LIFE AND EFFICIENCY OF INCANDESCENT LAMPS.

which they check each other, presumably correct; also that the candle power of the lamps is taken as the horizontal measurement perpendicular to the plane of the filament.

Filaments made of the same material and under similar treatment in various shops have the same characteristics, although bearing different factory names, and nearly all the real difference will be found in their cross sections and lengths, and lamps of different efficiency and of the same or different makes may be made to have the same efficiency when each is run at a certain voltage. For example: If a lamp be run at a pressure of 110 volts and is found to give 16 candle power at an efficiency of 3.6 watts per candle power and the pressure is then raised to 114 volts, it will give an illumination of 20 candle power at an efficiency of 3.1 watts per candle power, or, if the pressure be lowered to 108 volts, the lamp will give only 13½ candle power at an efficiency of 4 watts.

It is well known that the greater the initial efficiency of lamps the shorter their life, and the farther and more rapidly they will deteriorate with use.

Figs. 1 and 2 show the change in candle power and efficiency which similar lamps of various initial efficiencies undergo during their lives, from which may be observed that a lamp if run at a very high initial efficiency loses its candle power so rapidly as to soon become worthless; whereas if it were run at a low efficiency it would, after a few hundred hours' burning, reach a condition which it would maintain almost indefinitely, but it would produce light only at great expenditure of power. If fuel cost nothing, a low efficiency lamp would be the best to use.

The object of this discussion is to determine the most economical efficiency at which to run lamps in order to produce a given illumination, taking into consideration all the expenses of operating a lighting plant.

If we use a lamp of high efficiency, less power will be required and the entire operating expenses, except for lamp renewals, will be small, and the lamp renewal bill will be large. If, on the other, we use lamps of low efficiency, the bill for lamp renewals will be low, and the other

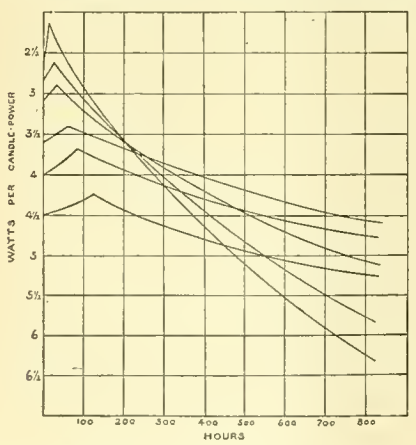



FIG. 2. MOST ECONOMICAL LIFE AND EFFICIENCY OF INCANDESCENT LAMPS.

operating expenses high. Also, as the efficiency of all lamps diminish steadily after a few hours' burning, they will eventually reach a point beyond which it will not be profitable to run them.

These are the two points to consider: First, the efficiency of the lamp; and second, the life of the lamp. To settle the problem distinctly, for a definite amount of light required and the most economical lamp life and lamp efficiency for which to provide in building a lighting plant to furnish the desired illumination, let us take a practical case of a factory or store requiring an illumination of 40,000 candle power for ten hours a day and 26 days a month.

To generate this amount of light we would usually provide two hundred horse power, which could be installed complete, with dynamos, circuits etc., for about $20,000. The monthly cost of labor to operate this plant might be as follows: Superintendent, $100.00; engineer, $90.00; electrician, $75.00; helper, $50.00; fireman, $60.00; total, $375.00.

To develop the 2,000 electrical horse-power hours required for a day's run would require in the case of a non-condensing steam plant of this size and kind, 30 pounds of water for each electrical horse-power hour, or 60,000 pounds of water for a day's run. To this add 20 per cent. lost in friction of the machinery, making a total of 72,000 pounds of water evaporated daily. Under moderately good conditions this can be done at a cost for fuel of 15 cents per 1,000 pounds of water, or for the day's run, $10.80. To this add 5 per cent. for fuel used in getting up steam and otherwise lost, and we will have a daily coal bill of $11.34, or for a month of 26 days, $295.

The fuel and other bills, which vary nearly with the load, are as follows for a month: Fuel $297.00; oil and waste $25.00; water $14,00; carting away ashes $25.00; total for month $361.00,

There is another class of expenses which are sometimes called general expenses. They are made up as follows: Interest on $20,000 at 6 per cent., $1,200.00; taxes, $400.00; insurance, $400.00; repairs and depreciation, 15 per cent, $3,000.00; rent, or value of space, $800.00; incidentals, $200.00; total annual general expenses, $6,000.00; or for a month, $500.00.

The monthly operating expenses, exclusive of lamp renewals, are thus made up of these items: Labor, $375.00; supplies $361.00; general expenses $500.00; total $1,236.00.

Each of these items will be greater or less depending

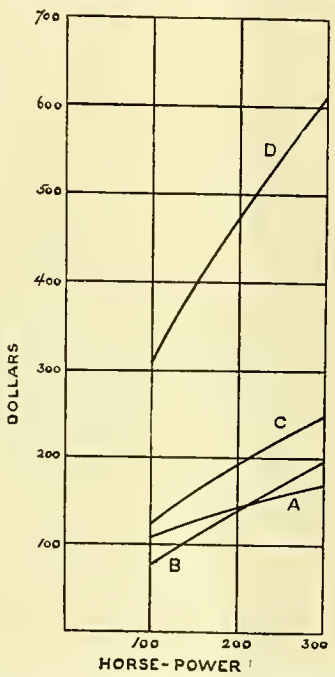



FIG. 3. MOST ECONOMICAL LIFE AND EFFICIENCY OF INCANDESCENT LAMPS.

upon the work which is done and for which the plant is built, but they will not vary in the same ratio. Should the capacity and work of the plant be doubled the labor will be increased 33 per cent. the fuel etc., 80 per cent, and the general expenses will be increased 55 per cent.

If the capacity and work be diminished one-half, the various operating expenses will decrease according to the same ratios. The variations in these three sets of expenses are shown graphically in curves *A*, *B* and *C* of Fig. 3, and the variation of the total operating expenses, lamps excepted, is shown in curve *D*, which is derived by adding the abscissae of curves *A*, *B* and *C*. These costs are for operating 100 hours.

TABLE I.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 20.4 | 20.4 | 20.4 | 1961 | 588. | 6200 | 12157 | 122. | 413. | 413 | 1001 | .0250 |
| 200 | 18.7 | 39.1 | 19.5 | 2951 | 615. | 12400 | 25432 | 127. | 425. | 850 | 1465 | .0183 |
| 300 | 16.8 | 55.9 | 18.6 | 2151 | 645 | 18600 | 40009 | 133. | 435. | 1305 | 1920 | .0162 |
| 400 | 15.7 | 71.6 | 17.9 | 2235 | 670. | 24800 | 55428 | 139. | 445. | 1780 | 2450 | .0153 |
| 500 | 14.2 | 85.8 | 17.1 | 2339 | 702. | 31000 | 72509 | 145. | 460. | 2300 | 3002 | .0150 |
| 600 | 13.1 | 98.9 | 16.5 | 2424 | 727. | 37200 | 90173 | 150. | 470. | 2808 | 3535 | .0148 |
| 700 | 12.6 | 111.5 | 15.9 | 2516 | 755. | 43400 | 109194 | 156. | 479. | 3553 | 4118 | .0147 |
| 800 | 12.1 | 123.6 | 15.4 | 2597 | 779. | 49600 | 128112 | 161. | 495. | 3960 | 4739 | .0148 |

Having before us the curves of Figs. 1, 2 and 3 we should be able to determine the cost of maintaining 40,000 candle power with each of the lamps taken. The method of determining this is shown in Table 1, which discusses the 3 1 watt lamp only.

Column 1 gives the number of hours which the lamp runs.

Column 2 gives the average candle power during each 100 hours from the time the lamp is started.

Column 3 gives the total candle power hours of the lamp from the beginning of the run to the end of each 100 hours.

Column 4 gives the average candle power during the same time.

Column 5 gives the number of lamps required to produce a constant illumination of 40,000 candle power when each lamp is allowed to attain the age indicated in column 1.

Column 6 gives the cost at 30 cents each of the number of lamps given in column 5.

Column 7 gives the total number of watt hours consumed by the lamp in question at the end of each 100 hours.

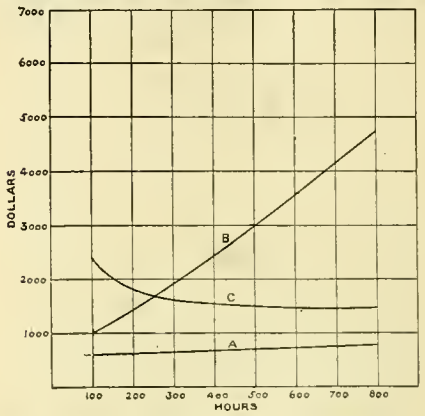



FIG. 4. MOST ECONOMICAL LIFE AND EFFICIENCY OF INCANDESCENT LAMPS.

Column 8 is the product of the numbers of column 5 into the numbers of column 7, divided by 1,000, and is the number of kilowatt hours required to maintain 40,000 candle power for the time indicated in column 1.

Column 9 gives the average number of kilowatts consumed by the lamps of column 5 in 100 hours. It is obtained by dividing the numbers of column 8 by the number of hours the lamps have run.

Column 10 gives the cost of everything but lamps for doing the work of column 9 for 100 hours. This is derived from curve *D* of Fig. 3.

Column 11 is the costs as given in column 10, multiplied by the number of hundreds of hours which each is to run.

Column 12 is the total cost of lamps and power, and is obtained by adding the corresponding numbers of columns 6 and 11.

We have now determined the costs of maintaining 40,000 candle power for one hundred hours with lamps having an initial efficiency of 3.1 watts, and run for various lengths of time. If we will now divide the cost of producing the light by the number of candle hours produced we will be able at a glance to tell which is the most economical length of life for this particular lamp. These quotients are given in decimals of a cent in column 13, and an inspection shows that with the cost of power and lamps as assumed, by using a lamp having an initial efficiency of 3.1 watts, 40,000 candle power can be maintained the cheapest by removing the lamps from circuit at the end of 700 hours.

The numbers in columns 6, 12 and 13 are platted in curves *A B* and *C*, respectively, of Fig. 4. Curve *A* shows the cost of lamps. Curve *B* is the total cost for power from the beginning laid off above the cost of lamps. The abscissae of this curve at any point show the cost of maintaining 40,000 candle power for the numbers of hours indicated, assuming that all lamps are to be removed from circuit at that age.

Curve *C* is the quotient obtained by dividing the total number of candle power hours run by the cost of operating during that time. These quotients are multiplied by ten

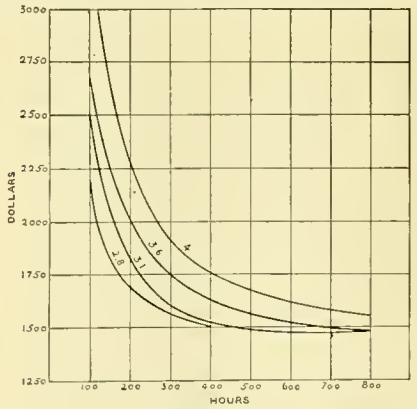



FIG. 5. MOST ECONOMICAL LIFE AND EFFICIENCY OF INCANDESCENT LAMPS.

million so that the variations of curve *C* can be seen on the same diagram with curves *A* and *B*.

In the same way lamps of other initial efficiencies have been investigated, and the final results are shown in the curves of Fig. 5, which are increased as curve *C* in Fig 4, from which we find that the most economical lamp to use, under the conditions we have assumed, is a 3.1 watt lamp, and the most economical length of time to run it is 700 hours. We also see that with this lamp there is very little difference in cost if the lamp is run 400 hours or 900 hours.

It may also be seen that there is very little difference in

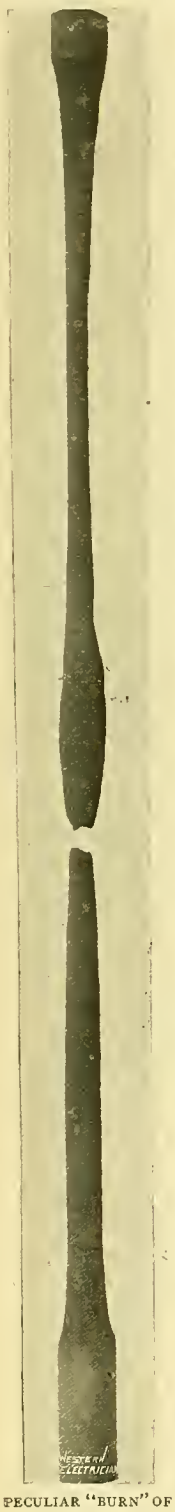
1. From the *Technograph*.

the cost of producing a given amount of light with lamps of various efficiency, provided the plant is adapted to the load and lamp used.

It may also be proven that if a lighting plant using 4 watt lamps 800 hours each were loaded to its full capacity, the output of light could be increased 20 per cent. by using 2.8 watt lamps which would increase the operating expenses only 12 per cent. No account is taken here of the loss of lamps by breakage, for the reason that when lamps are run at the efficiencies given the breakage within 800 hours would be so small that it could be neglected, except in the case of the 2.8 watt lamp, and its curve in Fig. 5 stops at 400 hours. As the lamps will not break during the time of their useful life, it will be necessary for the station superintendent to go around every day and remove lamps which are still burning and giving fairly good service, and while there is yet several hundred hours' life remaining to them. A superintendent who will do this of his volition the world has never seen.

## Peculiar "Burn" of Carbons.

In the accompanying illustration is represented a pair of carbons which are interesting from the extraordinary manner in which they have burned. They are of Helios manufacture, and are the property of S. G. Neiler, formerly of the electrical engineering department at the World's Fair. They were used in a Helios alternating arc lamp in one of the concession buildings in the Midway Plaisance upon a 104 volt secondary circuit of the Westinghouse company. The report shows that the lamp was trimmed as usual early one morning, and upon the succeeding morning the trimmer removed the carbons, and, owing to the peculiar way in which they had burned, he returned them to the general superintendent. No explanation could be given by the electrical department of the cause of this phenomenon. No complaint was received at the office of the operating department that the lamp had not burned during the evening or that it had acted unusually. There is every reason to believe that it worked, as at that time there was a very efficient patrol system, and a complaint would have been forwarded at once to the office of the operating department. Mr. Neiler advances no explanation and is entirely at a loss to account for the appearance of the carbons, as it was not possible for them to have slid by one another for they were found in their proper position in the morning and, furthermore, it will be noticed that each carbon has its perfect crater, which could not have been the case had the points of the carbons passed each other. It will also be noticed that the parts which appear as though worn away are perfectly round and uniform throughout. The lamp was of 30 volts and connected to an auto-converter placed across the 104 volt secondaries. It burned in the usual manner when another pair of carbons was substituted for the pair here illustrated, and the carbon holders did not present the appearance of having been burned.



PECULIAR "BURN" OF CARBONS.

## A Short-circuited Bird's Nest.

For about an hour and a half on themorning of the 7th instant, says the London *Electrician*, the electric lighting in the streets of Bath failed. Mr. Gatehouse reports that the failure "was due to a sparrow's nest having been built in the pipe which conveys the leads up the side of No. 10 Stall street to lamp No. 6. The nest probably pressed the leads close to the side of the pipe, and the rain trickling down the pipe saturated the nest with moisture, forming a semi-connecting circuit between them. These leads (or conductors) are covered externally with prepared hemp and jute which absorb moisture readily, and when they become saturated act in conjunction with the insulating material beneath them as a kind of condenser. When in this condition they are sufficiently close together for a small induced spark to pass, which ultimately destroys the insulation. This appears to have occurred in the present case, with the result that the nest took fire and the insulation broke down at this point."

## Dynamo with Tapering Field Magnet Core.

The Rev. Herman K. Thiel, a German Baptist clergyman of Alpena, Mich., has lately become interested in electricity, and has invented a new form of field magnet construction for dynamos and motors which has excited considerable attention. A picture of a dynamo built in accordance with Mr. Thiel's idea is given in Fig. 1, while the peculiarity of the field magnets is illustrated by Figs. 2 and 3, the former being a longitudinal cross-section through the machine and the latter a perspective view of the magnet core.

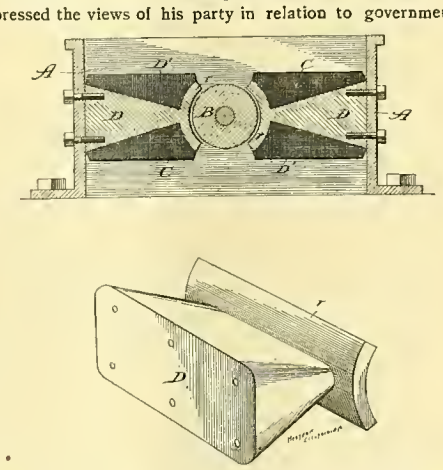
As will be seen by the drawings, the fundamental idea is to taper the magnet core toward the pole-piece to the end that the thickness of the field winding may be increased to the greatest possible degree in that portion of the magnet presented to the armature, thus securing, it is claimed, a much higher degree of magnetic efficiency and a larger number of lines of force than can be obtained from the same weight of copper and iron disposed in the ordinary manner of winding. By the use of the tapering core this is accomplished without altering the ordinary cylindrical appearance of the field magnet. It is claimed that the efficiency of the machine is greatly increased, owing to the enhanced concentration of the lines of force at the armature end of the magnet.

In the drawings, as will be clearly seen, *A* is the frame of the dynamo, *B* the armature, *CC* the field magnets, comprising the cores *DD*, the windings *D'D'* and the pole-pieces *rr*. The iron core is of laterally oblong shape and tapers regularly, on its four sides, from the rear end to the end which it presents to the armature, at which it is provided with the thin pole-piece *r*.

The small dynamo illustrated in Fig. 1 weighs 300 pounds without the wooden base and is said to have a capacity of generating 37 amperes at 110 volts. The claim is made for this magnet core that for a given output, either of dynamo or motor, the weight of the machine can be very materially reduced.

## Populists' Idea of Government Telegraphs.

In a recently published interview Senator Allen of Nebraska, one of the leading populists in Congress, expressed the views of his party in relation to government







FIGS. 2 AND 3. DYNAMO WITH TAPERING FIELD MAGNET CORE.

control of telegraphs as follows: "As to the telegraph, I think the general view of the populists is that since telegraphy affords means of public communication that are perfectly analogous to those supplied by the postoffice department, it also ought to be in the hands of the government and for the same reasons of common interest. But I would by no means favor a sudden or sweeping acquisition of the entire telegraph system of the United States. I should favor a very gradual beginning. I am creditably informed that the government still owns the old line that was originally established as an experiment between Washington and Baltimore. Let the postal department begin to operate that line, for instance, and then let postal telegraphy feel its way and make limited, gradual extensions. Ultimately, if the governmental system should approve itself, after due experience, it might grow to the extent of buying out and superseding existing corporations. I have in mind no policy by which the government would either directly or indirectly appropriate private property without making due compensation. But as to the rights of the government there can be no question."

## Experiments on Two-phase Motors.[1]

By Dr. Louis Duncan, S. H. Brown, W. P. Anderson and S. Q. Hayes.

Within the last few years rotary field motors have been greatly improved, and the conditions for successful design are moderately well understood. The problem has been attacked mathematically, and results have been obtained which, while interesting, have not been submitted to the test of experiment. The mathematical treatment is difficult, unless many essential phenomena are omitted; indeed, it is only lately that the solution of the case of a motor supplied from a constant potential circuit has been undertaken, and as this is the condition of actual practice the results, even with their evident limitations, are important and interesting. The phenomena that occur in the armatures of these motors are of special importance, but they have not yet been submitted to experimental investigation.

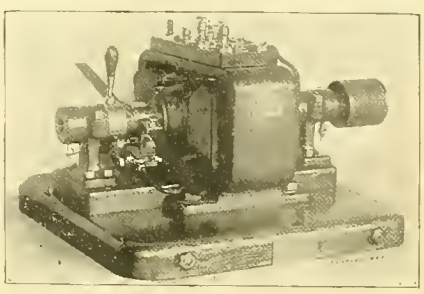


FIG. 1. DYNAMO WITH TAPERING FIELD MAGNET CORE.

The experiments of which this article is a description were intended for the purpose of developing a method of obtaining the current and electromotive force curves of multiphase motors, and of applying it to a two-phase, two horse power Tesla motor kindly furnished by the Westinghouse Electric & Manufacturing company. While the results are probably correct for the machine tested, yet as the motor was small, with inward projecting pole pieces, the results will differ considerably from those that would have been obtained on a larger machine, or one without projecting pole pieces. It was impossible for us to get any other machine, and the development of a method is, we think, of as great importance as the results themselves.

In a rotary field motor, if the resultant field is not exactly uniform, but presents some irregularities, then, if the difference between the speed of the field and the speed of the armature is not a multiple of both, the armature electromotive force will not in general be a periodic curve, because if we consider an armature coil enclosing a maximum number of lines of induction, then when it again includes the maximum number, the field will be in a different position with respect to the poles, and its maximum value may be different. Or to put it another way, if the difference of the speeds of the field and armature is not a multiple of both, then any particular armature coil will not have the same relative position with respect to both the field and the pole pieces in its successive positions of maximum induction. It is necessary then, in order to obtain periodic armature currents, that some form of gearing be employed.

If large machines are to be tested, where it would be inconvenient to transmit a large amount of power by gearing, the motor may be loaded until the desired speed of test is approximately attained, when a very light gearing between the dynamo and motor will serve to keep this speed constant, the gearing serving simply to check any small tendency toward a change of speed. In our own experiments the power to be transmitted was small, and the construction of the motor was such that we had no room for a gearing and for a coupling to a load. We consequently geared the motor to the dynamo, the motor energy being given back to the dynamo.

The apparatus experimented on consisted of a 25 horse power two-phase dynamo—an ordinary constant current machine supplied with four collecting rings—and one two-phase, eight-pole, two horse power Tesla motor. The electromotive force of the dynamo, as may be seen from the curves, was practically a sine curve. In our work the motor was not run up to its full capacity, as we were limited by the amount of power the gearing would safely transmit. We cannot better describe the armature winding of the motor than by quoting part of a letter written by Charles F. Scott of the Westinghouse company:

"The one you have has, however, 41 slots. The odd slot was placed in this motor so that the relation of the armature teeth to the field poles was different in different parts of the circumference, and the forty incipient dead points which might have occurred were avoided by the addition of the extra slot. The winding consists of four layers; the first and third are exactly similar and coincident in the slots occupied, and the second and fourth are similarly related. The four coils in each layer are connected in series and short-circuited."

The idea was to make the mutual induction of an armature coil with respect to the poles a sine curve. Of course,

[*Continued on page 19.*]

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A GLIMMERING prospect of the ultimate construction of an underground system of rapid transit in the city of New York continues to excite more or less interest in electrical circles. The new Rapid Transit Commission has instructed its engineer to prepare plans for an underground road conforming to the general scheme of the preceding board, and thus the preliminary work is again under way. Very likely something will come of the labors of the new board, but there has been so much tedious delay and playing at cross purposes in considering this important subject that it is difficult to arouse much enthusiasm at the prospect.

THE project for the electrical transmission of a portion of the power of Niagara Falls is suffering from a surfeit of talk. It has been conclusively demonstrated that the power could and could not be transmitted to Albany and sold at a profit for less than the present cost of producing power in that city. We are inclined to sympathize with the view of an English electrical contemporary which declares that it will be "relieved when the period of talk and interviewing is past, and glad when the two-phase alternators are generating energy to be delivered at Buffalo and elsewhere at a rate appreciably less than it can be obtained in the usual way. Then, and not before, engineers all over the world will be ready to recognize the commercial and engineering greatness of the Niagara scheme." Let us have a cessation of all this useless discussion and see something accomplished in the line of electrical work.

A YEAR ago the great electricity building at the World's Fair presented a scene of much animation and interest. It was filled with busy exhibitors and admiring visitors, and the pulsating commercial life of a great industry could be felt in every aisle. At night the spectacle presented by the flood of light and the novel illuminating effects was of exceptional brilliancy, and excited the praise and wonderment of thousands of onlookers. To-day all that remains of the proud structure is a blackened heap of debris; the bustling scenes of last summer are but a memory. It seems hardly credible that the great World's Fair buildings could have passed away in a single night, and the pictures given in this issue will possess a melancholy interest for a very large proportion of the readers of the WESTERN ELECTRICIAN. But the influence of electricity at the World's Columbian Exposition is indestructible and incalculable, and remains as the permanent good, although the visible exponent has passed away.

AN interesting question relating to the duty of telephone operators to the public is raised by the situation caused by a recent fire in Edwards, N. Y. The fire was a serious one, and until the telephone office at Edwards was burned repeated efforts were made to telephone to Gouverneur for a fire-engine. The endeavor to secure aid from the latter place was unavailing, however, owing to the fact, as alleged, that the telephone operators at Gouverneur were absent from their post of duty. It is freely asserted that if the operators had been at the exchange the fire-engine could have been sent to Edwards in time to save that village. It is difficult to see how the faithless operators can be punished, however, except by discharge from the company's service. Employes of railroad, telephone and telegraph companies are not public servants, although sustaining a quasi-public relation. If the citizens of the burned village of Edwards have any remedy at all, it must lie in an action against the telephone company for a possible violation of its charter due to the carelessness of its employes.

THE experiment of operating a conduit trolley railroad in the upper part of New York city will be awaited with much interest. The exact route is not yet settled, but it will be about three miles in length, and it is claimed that the line will be in operation before winter. The Metropolitan Traction company will build the conduit and furnish the power and cars, while the General Electric company will supply the electrical apparatus. The system is said to greatly resemble that in use in Budapest, with the exception that the conduit is in the center of the track instead of under one rail. Careful provision for cleaning and draining the conduit will be made, and the electrical contractor is confident of success. President Vreeland of the Metropolitan Traction company is reported to be very favorably impressed with the underground trolley system, and it is said that if the three-mile section is a success, the conduit system will be placed on all of the belt lines and side lines and in every street where there is a surface railroad, except in the main arteries of travel like Broadway, Third avenue and upper Sixth avenue.

IN view of the prevalent agitation to minimize or remove the danger of electrolysis to buried metallic pipes from the return current of single-trolley electric railway systems, it will be well for the Chicago companies contemplating electrical railway construction to carefully investigate this subject before beginning the work of line installation. By doing this much future trouble may be averted. It is, of course, much easier to make the suggestion than to outline an adequate and practicable remedy. The double-trolley system is always available as a last resort, but all electrical and street railway men are naturally extremely reluctant to consider the possibility of reverting to this expensive and cumbersome method. It is a question, however, whether it is not preferable to an elaborate system of underground return wires. In some cities, as in Hartford, Conn., for instance, the railway companies are obliged to agree that on all new lines "a supplementary wire shall be placed between the rails, and connected thereto, sufficiently large to return the electric current to the power station." It is doubtful whether this plan will prove satisfactory, but it is manifestly the duty of the Chicago companies to carefully consider this as well as all other proposed remedies.

THE French are forehanded in preparing for their international exhibitions, and undoubtedly much of the success that seems invariably attendant on an exposition in Paris is due to exhaustive preparation. The next great exhibition in the French metropolis will not be opened until 1900, six years hence, but active preparations are already under way. A commission has been formed and a scheme of classification proposed. The electrical and allied industries appear to be provided for in two groups. Group IV. is devoted to "The *Matérial* and General Processes of Mechanics," and comprises steam engines, motors, various apparatus in general mechanism and implements. Group V. deals with electricity, including the production and mechanical application of electricity, electro-chemistry, electric lighting, telegraphy and telephony. It is too early, of course, to make any prediction in relation to the electrical display, but it is safe to assume that the industry will then have settled down to such a solid commercial basis that the tiresome phrase, "Electricity is still in its infancy," will be regarded as nonsensical, even to the popular mind, as a similar reference to steam would be now.

THE great railway strike has wrought a baneful influence on the electrical industry as well as on every other business enterprise in Chicago. Supply men are greatly hampered for lack of facilities for shipping their goods to out-of-town purchasers, and the same state of affairs exists, of course, in relation to manufacturing electrical concerns. The decreased volume of general business also has its effect on the load of the central station companies, while there is the possibility of a graver complication by a strike of the electrical workers' unions in case all the associated labor organizations of Chicago decide to "go out" to show their sympathy for the American Railway Union. It is difficult to trace any connection between the relations of the wiremen of Chicago to their employers and the original strike at Pullman, but the primary cause of the trouble appears to have been lost sight of, and the contest has assumed the phase of a gigantic struggle between capital and labor, by which many thousands of innocent persons suffer.

Specific acts of depredation against the property of electrical companies have not been lacking. The electric railway cars at Pullman were stopped by the strikers for over a day, and trips were resumed only under the protection of the militia. At Hammond, Ind., which is practically a suburb of Chicago, serious rioting occurred, and the malefactors cut the electric light wires in order to destroy property under cover of darkness. Other instances could be cited were it necessary to lengthen the list.

But while electricity has suffered to some extent it has also provided very efficient means for combatting the lawlessness and disorder of the present outbreak. A striking instance of this is the use made of the long-distance telephone by Gen. Miles, the commander of the United States troops in Chicago, in communicating directly, by word of mouth, with President Cleveland at Washington. By no other means could the president and the officer in command have discussed the question so confidentially, with so little loss of time and with so much ease, although talking at points 900 miles apart. It is also interesting to consider that it is by the aid of electricity in the police telegraph and telephone system that the city authorities are enabled to receive instant alarm of disturbances in any part of this great city and dispatch forces to quell the trouble at once. In such a condition of affairs as at present exists in Chicago a city without means of electrical communication would be in a sad state indeed.

It is, of course, outrageously unjust that the electrical industries should be made to suffer owing to a labor dispute for which they are in no way responsible. The emergency is a serious one, and there is need of cool heads and calm counsel to prevent even more serious disturbances.

## Experiments on Two-phase Motors.

[*Continued from page* 17.]

with a limited number of slots, it is impossible to have the mutual induction of the field and armature exactly a sine curve. But it is possible to very nearly accomplish this, especially in large armatures, and the importance of it is beginning to be appreciated. Mr. Scott of the Westinghouse company was one of the first to appreciate the importance of the armature winding and the proper method

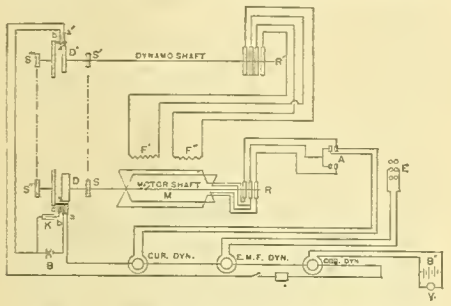



FIG. 1. EXPERIMENTS ON TWO-PHASE MOTORS.

of doing it, and he deserves much credit for his quiet and persistent work, which has resulted in the production of excellent motors instead of voluminous papers.

It is of course true that the period of the armature current is the sum of the periods of the field and the armature. As we wished to obtain the curve of the armature current by the contact method, it became necessary to get contacts whose period was the sum of the field and armature periods. This was obtained by an arrangement of apparatus shown in Fig. 1. In this figure, $S$ and $S'$ are the two sprocket wheels which gear the two machines together and give them the desired relative speeds. $S''$ and $S'''$ are two others which gear the graduated disks which carry the brushes. $D$ and $D'$ are the two instantaneous contact disks, one mounted on each shaft, and $a$, $b$, $c$, $a'$, $b'$ are the wiping brushes. $K$ is a condenser and $B$ a charging battery; $b$ and $c$ make the circuit through the battery and condenser once every revolution, thus keeping the condenser charged. When $a$ and $a'$ make simultaneous contact the battery circuit is broken and the condenser is discharged through the movable coils of the dynamometer which are all connected in series. $F$ and $F'$ are the motor field coils. $R$ and $R'$ the rings of the motor and dynamo respectively. $E$ is a double-pole, double-throw switch to which are connected the terminals whose potential difference curves are desired. $M$ is the motor armature, and $A$ is a switch in the circuit of the current instrument, $B'$ is a battery which sends a steady current through the large coils of a dynamometer. This dynamometer is used as a correcting instrument and the resistance in the condenser circuit is regulated to keep its deflection constant. If the brushes are set together on the contacts, and then the two machines revolve with a given speed ratio, say four to three the brushes will again be simultaneously on the contacts, when the machines have made respectively four and three revolutions. If the ratio was seven to six, the machines would make seven and six revolutions before the contacts would again be coincident. In this way we obtained the needed instantaneous current.

After obtaining one point on the curve in this way, and wishing to obtain another point, we must shift our brushes through angular distances proportional to the speed ratio of the two machines, otherwise they would not make simultaneous contact again. Having shifted them in this ratio (say, if the ratio is six to seven, we would shift 10 degrees on the dynamo disks, and six-sevenths of

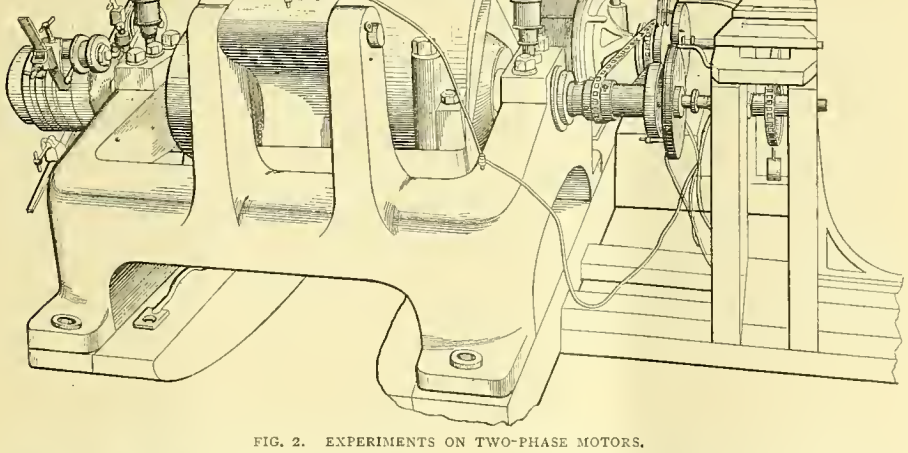


FIG. 2. EXPERIMENTS ON TWO-PHASE MOTORS.

10 degrees on the motor disk), we obtain another point on the curve. To accomplish this easily, we gear the brushes together in the same ratio as the armatures are geared, as is shown in Fig 1. Our gearing both for the brushes and armatures consisted of sprocket wheels and chains and was very satisfactory.

As the machine we tested was small, and was run much below its rated electromotive force, it was not, of course, particularly efficient, and as the armature efficiency is approximately the ratio of the armature speed to the field speed, this ratio was comparatively small, thus enabling us to use for measuring it a form of dynamometer which has been described before, and which was invented by one of us for obtaining such curves. It consists of a stationary coil carrying the current whose curves is to be obtained, and a movable coil through which passes an instantaneous direct current obtained by making the circuit on the armature disks before described. If this instantaneous current occurs when the alternating current is zero, we will get no deflection of the instrument. If it occurs when the alternating current is maximum, we will get a maximum deflection, and in general the deflection will be proportional to the instantaneous value of the alternating current. The dynamometer used had a long period and was well damped, and we had no difficulty in reading even when the period of the armature current was as much as one-quarter second.

If very efficient machines were to be tested, where the period of the armature current is very large indeed, then some electrometer method or a telephone method would be used or the deflection of a galvanometer needle in the field of the current could be easily photographed.

The curves we have obtained are as follows: The electromotive force applied to the armature; effective electromotive force of the armature; the counter electromotive force of the armature; the armature current; the value of field electromotive force and current for open and closed armature circuit. These are for ratios of three to four and six to seven.

We also obtained the various currents and electromotive forces when the armature was held stationary, with and without resistance in the outside circuit. There are really three distinct sets of curves; those relating to the three to four gearing, those for the six to seven gearing, and those in which the armature was stationary. The angular positions do not correspond for the first two sets. For the second and third they very nearly correspond. This is due to the fact that we did not at first clearly appreciate the importance of permanently fixing the relative positions of the armatures of the two machines. Afterward we made marks on each armature, and if for any reason we took off the gearing, we replaced it so these marks came opposite points which we fixed on the frames of the two machines. It should also be remarked that the curves for the two sets of armature coils marked $A$ and $B$ should not in general present the same irregularities, as their relative positions with respect to the poles and the resultant field are different. The dynamo being a four pole machine, this must be taken account of in calculating the angles on the base line. In Figs. 3 and 4 the contact positions should be multiplied by two. The length of an armature curve in terms of the positions of the dynamo brush should be $360 \times \frac{4}{3} = 720°$ in the case of the three to four gearing, and $360 \times \frac{7}{6} = 1260°$ for the six to seven gearing. We have not the same confidence in the results of the

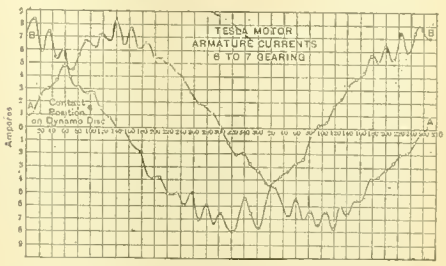



FIG. 4. EXPERIMENTS ON TWO-PHASE MOTORS.

three to four gearing as for the six to seven gearing, the latter being taken from several sets of observations which checked very well.

The curves of the applied electromotive force (curves V. and VI., Fig. 3, and II. and VI., Fig. 7) are obtained in the following manner. The armature was held station-

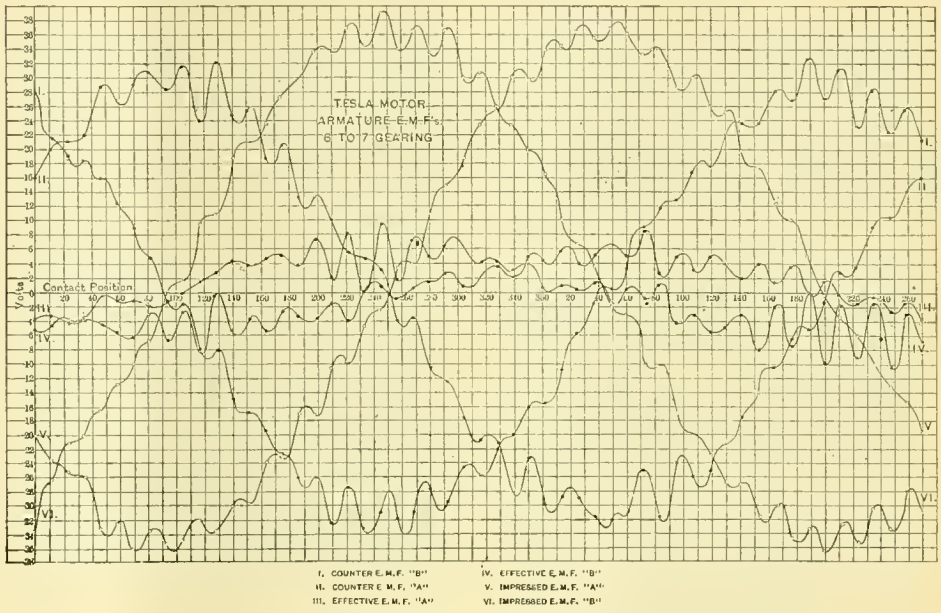



FIG. 3. EXPERIMENTS ON TWO-PHASE MOTORS.

ary, while the field revolved at its normal rates. The reading of our electromotive force dynamometer then gave us a point on the electromotive force curve. The armature was then moved through a given angle while the brush on the dynamo disk was moved through an angle corresponding to the ratio of gearing of the two machines. In this way another point was obtained on the curve. What we obtained was the electromotive force applied to the armature when there was no current flowing through it, and when the gearing was three to four or six to seven, according to the relative movement we gave the motor armature and the dynamo brush. It should be remarked

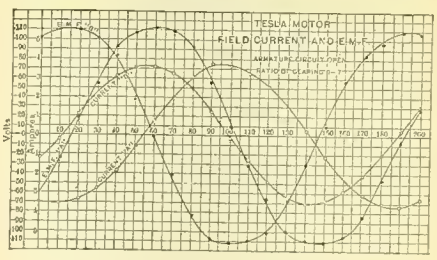



FIG. 5. EXPERIMENTS ON TWO-PHASE MOTORS.

that all of the armature curves marked electromotive force curves are obtained when the armature circuit is open, and therefore do not correspond to the actual condition of affairs when the armature is closed, as they do not contain the effects of armature reaction and self induction.

The effective electromotive force of the armature given in curves III. and IV., Fig. 3, and III. and IV., Fig. 7, were simply measured by opening the armature circuit, and getting the potential difference on the motor terminals when the motor was geared to the dynamo with ratios six to seven and three to four. The difference between these curves and the curves of impressed electromotive force, is the counter electromotive force, and is given by curves I. and II., Fig. 3, and I. and IV., Fig. 7. We could have obtained the counter elec-

tromotive force by supplying the fields with continuous currents whose ratio to one another would be that of the two-phase currents and varying the relative values of these currents as we vary the point of contact of our instantaneous current. This would have been a laborious task, and was not necessary. It was not possible to obtain these quantities by direct observation when the armature circuit was closed, and when the machine was running under normal conditions.

In Fig. 4 is given the armature current of the motor with a gearing of six to seven, and in Fig. 8 is given the current when the gearing is three to four. If we compare these curves we will see that the current is more irregular with the higher efficiency than with the lower. Again comparing the curves of effective electromotive force for the two gearings, we see again that the irregularity is greater with the higher efficiency. If we consider that the current would follow this curve of effective electromotive

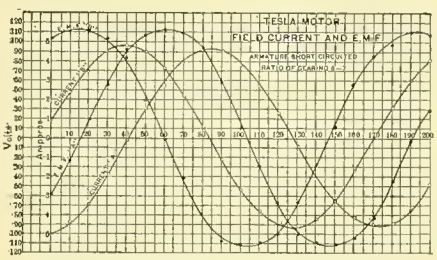



FIG. 6. EXPERIMENTS ON TWO-PHASE MOTORS.

force, but for the armature reactions and self-induction, we can see that these effects have their good as well as evil side. The effective electromotive force is of course the difference between the applied and the counter electromotive forces, and if these are irregular, their difference becomes the more irregular as they are the more equal in value, that is, as the efficiency of the motor is higher; so that while in this machine, whose maximum armature efficiency was made about 87 per cent, the irregularity is considerable, it would be very much exaggerated in a larger motor whose armature efficiency might be 97 per cent. or 98 per cent., and in this case great care should be taken to produce a perfectly regular field. The effect

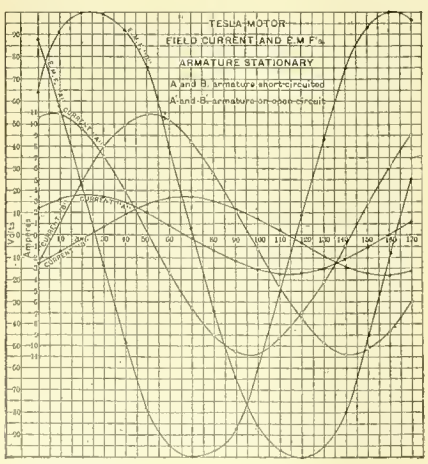



FIG. 9. EXPERIMENTS ON TWO-PHASE MOTORS.

of the armature reaction and self-induction is to decrease those irregularities.

If we consider for a moment the theory of the two-phase motor, we will remember that the armature efficiency is theoretically (leaving out losses in the field iron) $\frac{p'}{p}$ where p and p' are respectively the angular velocities of the field and of the motor armature. We will also remember that the lag of the armature current behind the effective electromotive force is taken as $\tan\theta = \frac{(p-p')L}{r}$. If we look at the curves, however, obtained with the motor experimented on, we will see that the armature current is irregular and

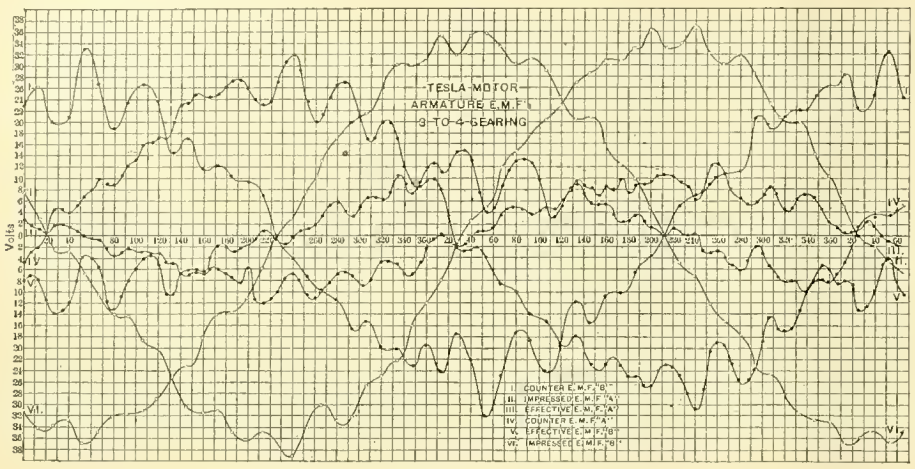



FIG. 7. EXPERIMENTS ON TWO-PHASE MOTORS.

therefore the actual heating would be greater than that calculated from sine curves; that is, the armature efficiency is always less and the drop in speed is always greater than the theoretical value, and may be very much less if the armature current is irregular. As has been pointed out, this fluctuation in the armature current would be exceedingly great if the self-induction and armature reaction

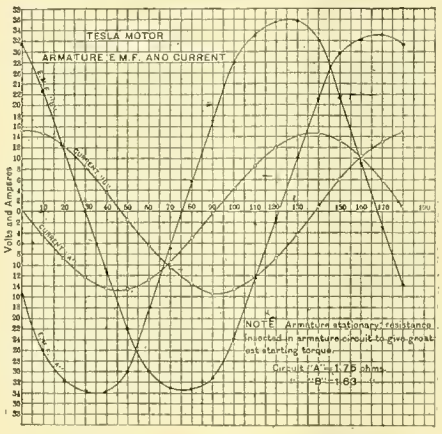



FIG. 10. EXPERIMENTS ON TWO-PHASE MOTORS.

of the motor did not tend to wipe it out, the effect of the self-induction being to damp the most the waves of shorter period, that is the irregularities.

It seems to us that the most important curves we have obtained are those of applied and counter electromotive forces, effective electromotive force, and the armature current. They show at once the great importance of designing a machine whose applied and counter electromotive forces are both sine curves, and the method may be easily used to experiment on actual machines and to find out if this condition is fulfilled. Again the comparison of the effective electromotive forces with no armature current with the fall of potential due to the armature current, shows us that there is some beneficial effect from self-induction in the armature. The principal results show the special machine does not give us regular currents and electromotive forces, but it is to a large extent due to the fact that in these small machines considerations of economy make it necessary to wind the field coils on spools instead of winding them through slots cut in the field iron.

In designing a motor to give absolutely regular electromotive force curves we must take two things into account: The field due to the dynamo current must be regular, and the armature winding must be such that it will give a regular electromotive force in a regular field. To satisfy this condition in the field windings, projecting pole pieces should certainly be avoided. To satisfy the condition in the armature would require an infinite number of armature windings, but it can be practically satisfied in the larger machines with a reasonable number of windings. It must not be understood that it is specially easy to accomplish this. Figs. 5 and 6 give us the input of the motor at full load and with an open armature with a six or seven gearing. Figs. 9, 10 and 11 show the field and armature electromotive forces and currents when the armature is stationary, and in one case short circuited, and in the other case has outside resistances in its circuits. Fig. 12 gives in arbitrary units the induction through a coil wound around one of the pole pieces, under the conditions stated.

We do not wish to add to an already lengthy paper a

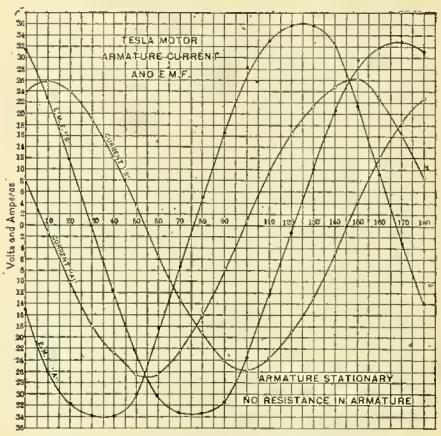



FIG. 11. EXPERIMENTS ON TWO-PHASE MOTORS.

prolonged discussion of the curves we have given, especially as we hope to be able to experiment on a larger machine, the results from which will be of much greater importance; but we think that the curves we have given show that the design of rotary field motors requires careful experimental study, and we believe that such a study may be easily made, even for machines of larger capacity.

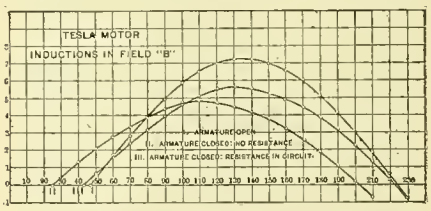



FIG. 12. EXPERIMENTS ON TWO-PHASE MOTORS.

## Electric Train Lighting in England.

In 1881 the Brighton company tried lighting Pullman cars by electricity from accumulators, and at the same time experimented on other trains with dynamos carried on the train itself and driven by the axle of the guard's van. About five years later, writes a London correspondent of the *Railroad Gazette*, the Great Northern adopted the latter system for "block" trains. A little later the Great Eastern spent a large sum in fitting up eighteen trains with accumulators in each carriage, charged from a dynamo worked by an engine carried on the tender, and driven by steam from the locomotive. The London & Northwestern and the Lancashire & Yorkshire also tried the same system, though on a smaller scale. The Midland also gave a trial to the donkey-engine system, but its principal experiment was made with axle power lighting. The plan, however, differed from that employed by the Brighton and the Great Northern in that the accumulators were placed in each carriage instead of altogether in the guard's van. The Midland experiments, moreover, were made not only on block trains for suburban traffic, but on express trains, liable to be broken up at various points and running at high speed.

The result of all these experiments, extending over thirteen years, has been that, as far as electric lighting for trains has won favor at all, axle lighting, as originally in-

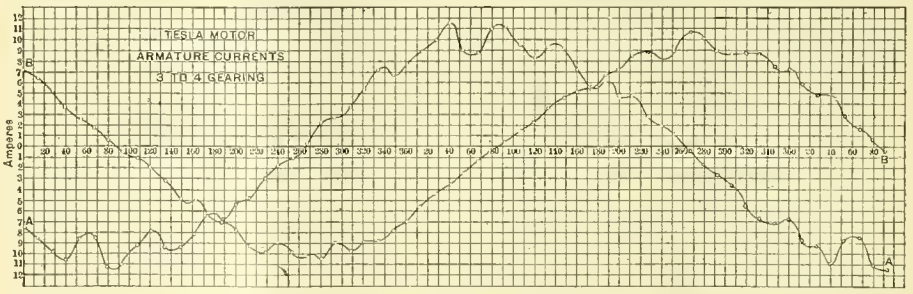



FIG. 8. EXPERIMENTS ON TWO-PHASE MOTORS.

troduced by E. J. Houghton, of the Brighton company, and subsequently adopted by the Great Northern, holds the field, and these two companies are the only ones which now run electrically lighted trains.

The Brighton company has 28 suburban trains of 10 carriages each, and four main-line fast trains equipped with this system, making a total of 300 coaches, and eight additional suburban trains are now in course of equipment. This will bring the number up to 40 trains, with a total of 400 carriages, including nine Pullman cars. The Great Northern company has eight suburban trains electrically fitted. It is not at present contemplating any addition to its stock.

The system employed on the Brighton is as follows: The dynamo and accumulators are placed together in the guard's van at the end of the train in a cupboard which occupies about two feet only of the van's length. Brush five horse power dynamos, capable of working up to 80 volts and 55 amperes are employed. They are furnished with a pulley at each end. Belts are led direct from the far axle of the carriage to the dynamos. As soon as the train moves the dynamos begin to turn. Attached to the dynamo by means of a small strap is a centrifugal governor which works in accordance with the speed of the dynamo. When the train attains any prearranged speed—say eight miles per hour—the governor jams up an electro-magnet thereby putting the accumulators in circuit with the dynamos and causing the latter to commence charging the

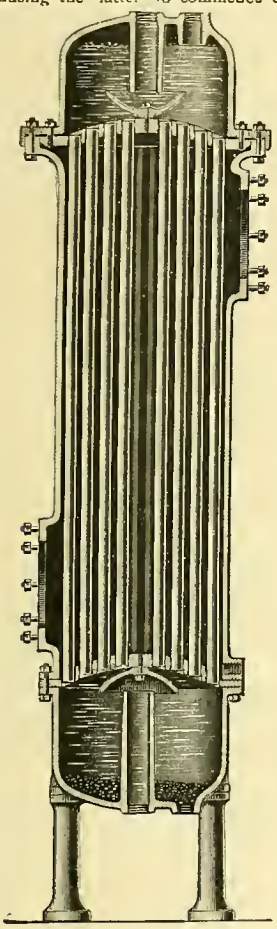


FIG. 1. IMPROVED GOUBERT FEED WATER HEATER.

former. As the speed of the train increases, the electromotive force of the dynamo rises and the governor gradually draws the brushes forward so as to prevent sparking at the commutator. As the speed of the train diminishes, the reverse operation takes place, the brushes gradually returning toward their original position until the speed drops down to eight miles per hour, when the governor breaks contact and the dynamo ceases to charge. The dynamo is fitted with double sets of brushes and works equally up or down; the direction of rotation of the governor determining which shall be brought into use. Placed in the dynamo circuit is a regenerator consisting of a solenoid with an iron case, to which is attached some German silver wire made in the form of a spiral spring. This resistance is in the lamp circuit, and acts in such a manner that as the electromotive force in the dynamo circuit varies, more or less resistance is automatically inserted in, or removed from, the lamp circuit, thus maintaining the light practically constant.

The system in use on the Great Northern trains differs in one important particular only from that just described, viz., that the connection between the dynamo and the accumulators is effected by electrical instead of by mechanical means. In the Great Northern system an automatic electric switch puts the dynamo into circuit with the accumulators and lamps when the electromotive force of the dynamo exceeds that of accumulators, and disconnects when the excess is from the latter. The lamps are installed in parallel between two main conductors, and are turned on and off by the conductor by means of a hand switch.

The Great Northern lamps are 16 candle power for first-class compartments, 12 candle power for second class, and 8 candle power for third class. The Brighton lamps are 10 candle power nominal, but can be worked up to 16 candle power. They now cost 18 cents each, and last six months. The accumulator plates last about two and three-quarter years, but have to be dismantled every 16 months and thoroughly cleaned. They have a capacity of 350 ampere hours.

As to the first cost the Brighton electrician says $1,948 per train, and the Great Northern £7 per lamp, which, calculating 50 lamps to a train, works out at only $1,704. This is admitted, however, to be a minimum estimate. The cost for maintenance of the Brighton trains for the 12 months ended December 31, 1893, is stated to have been $304 per train. The Great Northern trains, on the other hand, are estimated to cost $536 each to maintain, and the wide difference betwen these figures does not seem to be satisfactorily covered by the statement that the Great Northern service is much the more severe. The Brighton light, it appears, is required hardly at all in the day time, whereas the two sets of tunnels, through which every train leaving and entering the Great Northern terminus has to pass, make it necessary for some light to be supplied on every suburban journey on this road. Moreover, it is stated that the Great Northern supplies a greater number of lamps per train.

Both companies anticipate a considerable reduction in working charges now the lamp patent has expired, and when the accumulator patent runs out, as it will shortly. It is also agreed that the larger the number of trains the less the the average cost per train, the same number of men at present employed to meet the trains and overhaul the apparatus being sufficient for a considerable addition to the stock. The Brighton electrician estimates that when his further eight trains are running, the working cost per train per annum will be as low as $244. The fact that the Brighton company has all along had more trains running than the Great Northern has probably something to do with the fact that the estimated working cost is so much less on the former road.

Summing up on the general question of the suitability of electricity for train lighting, the results of English experience may be said briefly to be this: that axle lighting is the only system which has practically proved its capacity for doing the work required of it, but that this system, as at present in use, is properly suited only for "block" trains, i. e., trains which perform successive journeys with the same carriages, such as are used mainly for suburban service. It seems conclusive evidence of the failure of electricity to prove its capacity for all the requirements of railroad carriage lighting that the Brighton company, which has taken so much pains to develop electric lighting and for years made electricity its only alternative to oil lamps, has now brought itself into line with all the other leading English companies by ordering the erection of oil gas works on the Pintsch system on a large scale, both at London and Brighton. It is true that at the same time the directors ordered the equipment, as before stated, of eight new trains with electric lighting plant, but these are all for suburban service.

As to the comparative cost of electricity and gas, trustworthy figures are very difficult to obtain, but the general opinion seems to be that the initial cost of plant works out at about the same figures per train, while the economy in maintenance is slightly on the side of electricity; at any rate, it is thought that this is so on roads passing through many tunnels, on the trains of which gas has to be kept burning continually, while electricity can be switched on and off. It is also estimated by the advocates of electric light that trains thus equipped can do about 15 per cent. more work than gas lighted trains, which need to be hauled at intervals to charging stations.

With regard to future improvements in method, very little faith is felt here in storage battery lighting, such as was described recently in the *Railroad Gazette* as in use on the Chesapeake & Ohio. A similar system was tried on the dining cars of the East Coast route to Scotland, and speedily abandoned, owing to the difficulty of making batteries suitable to go under the cars, the weight of the batteries, the inconvenience of re-charging and, above all, the expense, which was £130 per car, or more than it cost to maintain the lights of a whole suburban train. Railroad electricians here, however, are hopeful of being able to overcome the great difficulty now blocking electric lighting progress, namely, its lack of applicability other than "block" trains. The Great Northern electrician believes that it would be practicable and not too costly to have stationary dynamos at junctions, by which carriages detached from main line expresses could be sufficiently charged for their journeys down branch lines. He believes, however, that it would be desirable to have a separate small set of cells in each carriage for this contingency, the larger accumulators being brought into use again when the car was once more coupled on to a main train. It seems that the difficulty of coupling and uncoupling is not so much an obstacle to the application of the present system of axle lighting to detachable cars as the fact that the accumulators, if emptied during the journey of such a car down a branch line, could not stand the strong currents of electricity that would at once pour into them upon their being coupled up to cars containing cells fully charged. It was partly this difficulty, and partly a failure of belts, due, it is alleged, to a prejudice on the part of the electrician against the link belts which have been used so successfully on other roads, that caused the abandonment of the Midland experiments with carriages independently equipped on the axle system.

## Columbia Telephone Set.

The Columbia Telephone Manufacturing company, New York, has placed upon the market the telephone set shown in the accompanying illustration. The company controls the patents of James W. McDonough and H. H. Eldred as well as those of other inventors. The instrument is provided with a multiple contact carbon transmitter. This consists of a series of pencils resting in bearings and having their bearing points rose-shaped so as to afford a number of sharp contact points. The carbons are attached to the under side of a thin wooden diaphragm against which the speaker's voice is directed. The receiver when not in use is suspended on a hook at the top of which a switch is placed. When the receiver is suspended on the the hook a bell rings and continues ringing

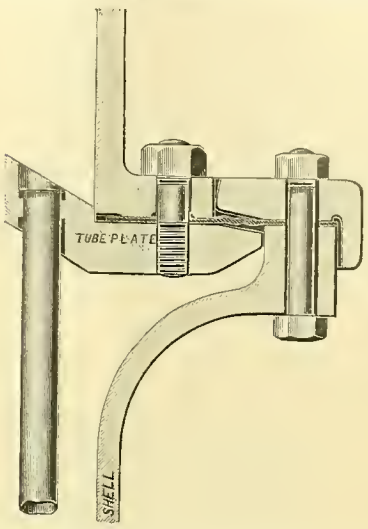


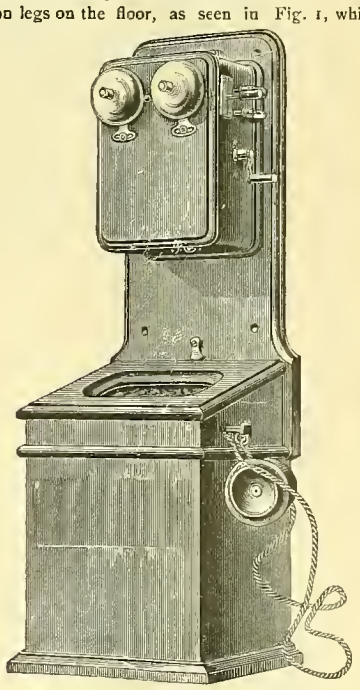

FIG. 2. IMPROVED GOUBERT FEED WATER HEATER.

until the switch is thrown over, thus cutting out the battery and preventing it from running down.

Besides the instruments described, the company will shortly bring out a simple and ingenious automatic telephone exchange system which permits of a subscriber putting himself in communication with any other subscriber without the intermediary of an operator at the exchange.

## Improved Goubert Feed Water Heater.

The construction of the improved Goubert feed water heater for electric lighting and traction plants is shown in the accompanying illustrations. This feed water heater is composed of two cast iron water chambers, connected together by a cluster of seamless drawn brass tubes, rigidly secured at their ends to the tube-plates by means of a roller tube expanded in the same manner that boiler tubes are secured to the heads. These are the only parts of the heater under boiler pressure. The lower water chamber rests on legs on the floor, as seen in Fig. 1, while the



COLUMBIA TELEPHONE SET.

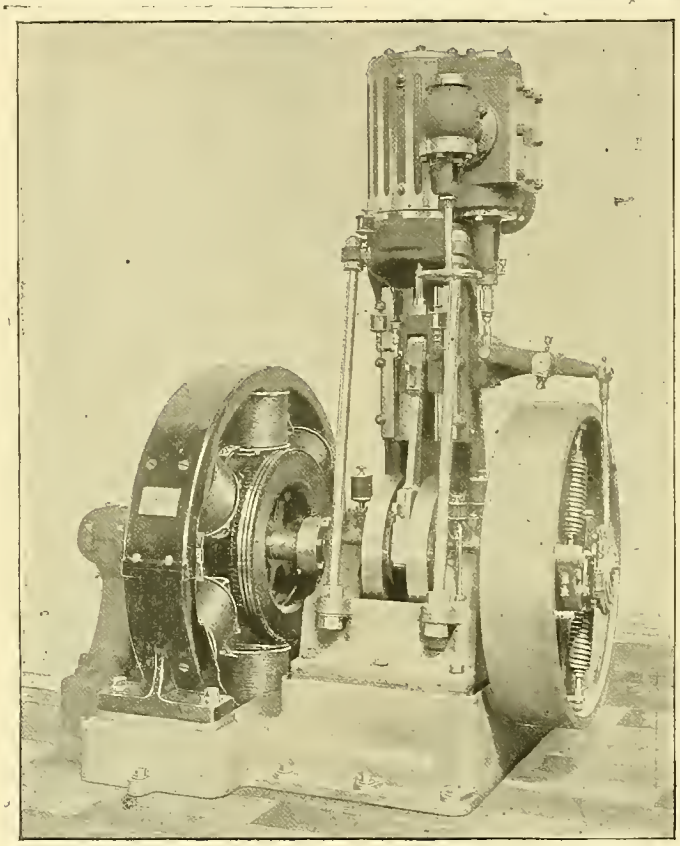
upper water chamber is free to move vertically as the tubes expand or contract. The tubes are surrounded by a cast iron shell provided with inlet and outlet nozzles to which are connected the exhaust pipes. This shell is bolted to the lower water chamber but is free to expand independently of the tubes, by means of the patent joint shown in Fig. 2.

This joint adds greatly to the value of the heater and is a recent improvement. It is between the heater shell and

the upper water chamber and is the only joint in the heater that is not rigid. Its object is to take care of the different rates of expansion in the shell and brass tubes. It is constructed so that either the shell or tubes may expand independently of each other, an intervening copper gasket bending sufficiently to allow for the differential expansion. While free to move with the expansion of either tubes or shell, the upper tube plate fits sufficiently close within the shell to prevent any injury from racking and consequent loosening of the tubes in transportation. The pressure in this heater being within the tubes, the shell and expansion joint have only to withstand the pressure of the exhaust steam. These points, combined with the other peculiar advantages of the Goubert feed water heater in its high class construction, make it a superior piece of apparatus. It is built for high steam pressures and especially well adapted for the service of electric traction plants. The Goubert Manufacturing company, New York, the sole manufacturer, is represented in all the principal cities by well-known firms.

## Directly Connected Outfit of the General Electric Company.

The accompanying illustration shows one of the four compact plants which the General Electric company has



DIRECTLY CONNECTED OUTFIT OF THE GENERAL ELECTRIC COMPANY.

recently installed in the Manhattan Life Insurance building, New York. It consists of a six pole, 25 kilowatt, 300 revolution, iron clad generator, connected to the shaft of an Armington & Sims vertical, 40 horse power, 9½ by 10 inch engine. The other three consist of 50 kilowatt generators and 80 horse power engines. These small directly connected generating sets are now being built in large numbers by the General Electric company at its Schenectady works, the demand for them having become widespread. They occupy but comparatively little space, and this feature alone recommends them highly for all isolated plant or marine work; they are solidly and substantially built, and wherever they have been installed have given general satisfaction.

The new stretch of trolley road between the North Clark street cable barn and Graceland avenue, Chicago, was put in operation on July 8th, the electric cars coming straight from Evanston to the barn without change. The route from Graceland avenue is on Evanston avenue to Halsted, to Clark, to the barn.

The Geneva, N. Y., Electric Street Railway company began regular operations on July 2d, and is now sending cars over its line on schedule time. The road connects the railroad stations with the business and residence centers of the place. The patronage has been large. The company proposes to bond the road for $75,000 for the purpose of securing funds to extend the line to Waterloo. It is assumed that Geneva capitalists will buy a portion of the bonds.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, July 9.—The new rooms of the rapid transit commission are on the ninth floor of the Home Life Insurance Company building, opposite the city hall, as convenient to the mayor's office as possible. At the last meeting the proposed by-laws were read, and after some discussion were adopted. It was decided that the commission should meet every Tuesday night. Mr. Starin was elected vice-president and Mr. Claflin was unanimously elected treasurer. On motion of Mayor Gilroy it was unanimously resolved, "That the chief engineer confer with counsel and that he proceed to prepare plans and specifications conforming to the general plans for an underground road, adopted by the predecessors of this board."

Lawrence Arnold of 109 East Ninth street was killed by electricity last week in Jackson's dry goods establishment at 777 Broadway. While repairing an electric fan on the second floor he received a shock which caused instant death. Beneath the fan stands a radiator. In order to reach the fan Arnold stood upon the radiator. He had been working at the fan only a few minutes when those in the room heard a stifled cry, and as they looked in that direction they saw Arnold's body sway backward and fall heavily to the floor. The only cause that is assigned for Arnold's death is that while standing on the radiator he touched with his hand a poorly insulated wire, the radiator forming a circuit for the current through his body.

The Nassau Electric Railroad company made a connection with Flatbush avenue in the Twenty-ninth ward of Brooklyn, through East Broadway and Church lane, last month. The company expects to connect with the Thirty-ninth street ferry soon.

A hearing was given the Coney Island & Brooklyn Railroad company on its application for a change of motive power from horses to electricity by the State Board of Railroad Commissioners, June 28th. The commissioners, at the request of Assistant Corporation Counsel Angell, adjourned without taking any action in the matter.

A dispatch to the *Herald* states that the cable steamer Faraday anchored off the port of Canso, N. S., July 4th, having completed the third Atlantic cable for the Commercial Cable company. The new cable is of the heaviest type, with the largest copper conductor and the speediest ever laid for the length. The contractors, Siemens Brothers & Co., guaranteed it to be 33 per cent. faster than either of the two cables laid in 1884 for the Commercial Cable company, and the tests now being taken show that the speed is greater than the guarantee. The Faraday has broken the record in Atlantic cable laying, the actual time engaged in the operations being 20 days. Laden with the balance of the shallow water and the whole of the deep sea portion of the new cable she sailed from Woolwich, England, on June 12th. The bottom of the ocean was dragged a number of times to recover portions of the cable, and although head winds and bad weather characterized the voyage, not a hitch marred the excellence of the work. The ship was constantly in communication with the station at Waterville, Ireland, and was kept fully informed of what was going on in the outer world. On Sunday, June 24th, consternation was occasioned aboard at the news of President Carnot's assassination. The previous day the birth of the Duke of York's son was flashed through to the ship, and the following congratulatory message sent:

"Mid Atlantic, lat. 50° 16′ N., lon. 39° 20′ W.—To Sir Francis Dewinton, York House, St. James Palace, London:—May I ask you to be kind enough to convey to their royal highnesses, the Duke and Duchess of York, the hearty congratulations and best wishes of the whole ship's company of the steamship Faraday, now engaged in laying the third Atlantic cable for the Commercial Cable company.

"Signed, ALEX. SIEMENS."

On the 27th the acknowledgment was received. From Sir F. Dewinton to A. Siemens:—"The Duke and Duchess of York thank very warmly the whole ship's company of steamship Faraday for their kind congratulations, and they wish them success in their labors." These congratulations must have been considered unique by their recipients, as they were flashed to land from mid-Atlantic.

W. F. O.

## PERSONAL.

E. A. Sperry of Cleveland called on several of his Chicago friends last week.

H. C. Porter returned to Chicago last week from an extended business trip in the East.

Silas W. Moore, manager of the Lima, O., Electric Light & Power company, died on June 22d.

H. Durant Cheever, manager of the Okonite company, is in Chicago. Mr. Cheever has been spending a few days at Lake Geneva.

H. L. Parker, president and manager of the Emerson Electric Manufacturing company of St. Louis, is in Chicago on a visit combining business and pleasure.

F. W. Cushing, who has gone abroad in the interest of the telautograph, writes from London to friends in Chicago to say that he has decided to remain in Europe for at least a year.

Prof. Amos E. Dolbear of Tufts College delivered a lecture on the "Future Developments of Electricity" last week in Manchester, N. H., at the invitation of the Manchester Electric club.

E. W. Goldschmidt of the Western Electric company, Chicago, was married last month to Miss Maude Kimball of Champaign, Ill. Mr. and Mrs. Goldschmidt left for San Francisco immediately after the wedding ceremony.

James E. McElroy, head of the firm of James E. McElroy & Co. and treasurer of the Harrison International Telephone Construction company, died suddenly on June 30th. He will be succeeded by his brother, Robert L. McElroy.

A. R. Jennings, formerly with the Graves Electric & Machine Works, Cleveland, O., spent a few days in Chicago last week. Mr. Graves expects to locate in St. Louis soon to act as manufacturers' agent for several concerns.

## NEW INCORPORATIONS.

Kansas City Electric Street Railway company, Kansas City, Mo.; capital stock, $1,000,000; Benjamin Jones, Ozone Park, N. Y.

Ambler Electric Railway company of Montgomery county, Ambler, Pa.; capital stock, $12,000; to build and operate an electric road upon the principal streets of Ambler; W. B. Krick, Reading, Pa.

Leavenworth Electric Railroad company, Leavenworth, Kan.; capital stock, $300,000; to construct and operate a railroad by steam, electricity, cable or other mechanical power, telephone and telegraph lines, etc.; W. D. Bethel, Memphis, Tenn.

## TRADE NEWS.

The C & C Electric company, manufacturer of dynamos, motors, etc., has issued a partial list of the users of C & C generators and motors. The list is of sufficient size to fill a book of 62 pages and is a fine testimonial to the popularity of the C & C apparatus. The Chicago offices of this company is at 1020 Monadnock building.

S. F. B. Morse of the firm of Cushing & Morse, general western agents for Kerite wire and cables, has just returned from an extended eastern trip, during which he visited the Kerite factory at Seymour, Conn., as the guest of W. R. Brixey, owner of the plant. Mr. Morse found the factory running on full time, and witnessed the very satisfactory operation of the new lead press recently added to the plant. The increasing demand for lead encased Kerite

cables necessitated the installing of this new press, which embodies all the latest improvements and enables Mr. Brixey to turn out the very best work possible in this line.

G. K. Hooper has opened a Western office for the Abendroth & Root Manufacturing company of New York at 1422 Monadnock building, Chicago. This company is the well-known manufacturer of sectional water-tube boilers, and it proposes to make a more active effort to secure western business than heretofore. Mr. Hooper formerly had charge of the company's office at Rochester, N. Y., and comes to Chicago with good prospects of success in his new field.

The catalogue of the Racine Hardware company, dated July, 1894, and descriptive of the Racine automatic engine, has just left the press and contains some interesting data concerning steam eogines. The company manufactures two types of engines to which it has given particular prominence, one being of vertical construction and the other horizontal. Both engines are described in detail and illustrated in a satisfactory manner. The Racine marine engine and the Racine safety boiler also occupy some space in the catalogue, as well as some of the other articles manufactured by this company. The address of the company is Racine, Wis., and it has a Chicago office in the Home Insurance building.

## BUSINESS.

The Clonbrock Steam Boiler Works, Brooklyn, N. Y., have closed the contract for a battery of boilers aggregating a capacity of 4,000 horse power with the Edison Electric Illuminating company, Pearl street, Brooklyn.

The Harrison International Telephone Construction company has moved its general offices to the Chamber of Commerce building, Chicago. The general offices of the Harrison International Telephone company will remain at 41 and 46 Wall street, New York. The change was made necessary by the growth of the western business of the construction company.

The Jewel Belting company, Hartford, Conn., reports a decided increase of trade during the last two weeks. Among the company's recent sales for belting for electrical plants are orders for 160 feet 24 inch, 384 feet 28 inches, 130 feet 30 inch, 167 feet 40 inch, 105 feet, 48 inch, and 189 feet 55 inch, all double belting. With the present orders on hand the Jewel company feels that the fall trade will again show business where it has been in the past, and it is making arrangements to take care of such an increase.

The Central Electric company, Chicago, has upon exhibition in its store a board of Hart switches, finished in the trimmings of the new store and matching it perfectly, which was presented to the Central company by the Hart & Hegeman Manufacturing company, Hartford, Conn. It contains samples of the variety of the switches manufactured by the latter company, including five and ten ampere single pole, ten ampere double pole, and ten ampere three way. The fan motor stock of the Central Electric company is simply "played out," for during the recent spell of hot weather it sold almost its last fan motor. By a special effort, however, it will be able to meet the demand which is being made for the Lundell motor.

The Eddy Electric company, Windsor, Conn., is at present taking inventory and expresses itself as well pleased with the showing for last year. With the exception of a few days the factory has been very busy in filling orders, and the company has now a large quantity of work on hand with prospects for an unusually brisk trade during the fall. A recently constructed reservoir of large capacity, in addition to one in use, will furnish an abundance of water for fire purposes. The Eddy company is now manufacturing generators and motors of all capacities, and since its installation for Whitman & Barnes of West Pullman, Ill., has received a large number of inquiries for work in this line, several concerns having in mind radical changes, and are now in communication with this company.

The Packard mogul lamp has found another field of usefulness, this time in connection with electric railway work. Enterprising electric street railway companies often furnish some kind of summer attraction at points along their lines, and thus increase their passenger traffic. The point selected is usually a park, and special attractions, such as concerts and extra illuminations, are furnished. It is here that the Packard mogul lamp has its application, and a large number of roads are already using it for this work. The lamp is particularly adapted for the work, as the cost of installation is slight compared with arc lamps and the result is usually effective. The lamps, as generally used, are burned four or five in series direct from the railway circuit. The Electric Appliance company, Chicago, has furnished a number of such outfits.

The following is a copy of a portion of a letter addressed to the power and mining department of the General Electric company, by General Manager Clark of the Coeur d' Alene Silver & Lead Mining company in Idaho, regarding an electric plant furnished that company by the General Electric company: "In respect to the relative merits of steam and electricity at the Poorman mine, I will say that the amount saved in fuel is about $100 a day. This, of course, is due to the fact that we generate electricity by water power. We have five machines in use; two of 175 kilowatt capacity at the generating station one and one half miles distant from our works, where they are operated with Pelton wheels under 800 feet head; one of 175 kilowatt capacity to drive our concentrator; one 150 kilowatt machine for the pump, raising 500 gallons of water per minute 500 feet; and one 175 kilowatt machine for the compressor. This system has been almost two years in operation."

The Charles E. Gregory company, Chicago, reports the following sales for June: One 50 light D. 12 Thomson-Houston arc dynamo to Pliny Norcross, Janesville, Wis., two 30 light and one 20 light Sperry dynamos to B. Marks, Chicago; one six light Sperry arc dynamo to James I. Ayer, New York, one three light Excelsior dynamo to J. P. Carr, Reynolds, Ind., a 500 light 1000 volt Thomson-Houston alternator to P. Milroy, Hopkinton, Ia., two 180 ampere Westinghouse generators to the International & Wells Packing company, one 180 ampere Westinghouse generators to W. T. Osborn, Kansas City, Mo., one 210 light Edison generator to George B. Weise & Sons, Chicago, a 25 horse power D. R. Westinghouse motor to O. H. Parker, Anniston, Ala., three three horse power Westinghouse motors to Andrews & Johnson, Chicago, one five horse power Edison motor to Andrews & Johnson, Chicago, one two horse power Sperry series motor to John Raber, Chicago, one three kilowatt Edison motor to M. Schu, Aurora, Ill., one three kilowatt Edison motor to the Chicago Braid & Embroidery company, one one horse power Crocker-Wheeler motor to the Four Lakes L. & P. company, Madison, Wis., one one horse power C. & C. motor to A. L. Daniels, Marion, Ia., one one horse power Jenney motor to E. J. Davis, Aurora, Ill., one one horse power Rockford motor to George Wolf, Chicago, Ill., one one horse power Detroit motor to the Baltimore cafe, Chicago, Ill., one one horse power Crocker-Wheeler motor to Lyon & Healy, Chicago, Ill., one one horse power Edison motor to Goltz & Sinclair, Milwaukee, Wis., 14 Edison arc lamps to W. T. Osborn & Co., Kansas City, Mo., six Knowles D. C. arc lamps to Kuh, Nathan & Fischer, Chicago, six Edison arc lamps to B. F. Harris Jr., Champaign, Ill., 15 Edison arc lamps to M. Eichberg, Chicago, and a total sale of 147 fan motors of all kinds. Mr. Gregory reports that the demand for apparatus is far in excess of the supply, and that purchases of dynamos and motors were made during the month in Boston, Philadelphia and San Francisco for the company's stock.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued July 3, 1894.*

522,189. Electric Railway Truck. Francis O. Blackwell, Lynn, Mass.

In order to facilitate the driving of both axles from one motor, the truck frame is substantially rigid on the axles *B B* so as to hold them in in approximate alignment. The motor *C* is carried by bolsters or cross-bars *D D*, which are yieldingly supported on the side bars, *a*, *a'* of the truck frame, preferably by springs or cushions supporting the motor against both upward and downward displacement. The motor shaft *c* is placed longitudinally of the car and is connected at each end to bevel pinions *F*, gearing with bevel gears *G* on the axles. In order that the motor may move freely up and down on the springs without interference with or by the connection to the axle, a flexible coupling *H* is interposed between the motor shaft *c*, and the axle, which while transmitting the torque of the motor shaft to the axle, allows each to yield or shift to some extent independently of the other. The flexible coupling is interposed between the motor shaft *c*, and bevel pinion *F* and consists of jaws or arms *h* and *h'* respectively on the motor shaft and the bevel pinion, and connected by the cross or four armed frame *h²*, the cross sliding loosely in holes in the jaws.

522,209. Organ. Robert Hope-Jones, Birkenhead, England.

This invention, which is illustrated in the patent record by 60 illustrations and which embraces 36 claims, relates to improvements pertaining to apparatus for combining, varying and controlling the speech of the various pipes, reeds, bells, etc., in organs or similar instruments in a more effective, rapid and convenient manner that has hitherto been accomplished. Electricity and air pressure, or vacuum, are so employed as to enable a performer to admit or shut off the supply of wind to each pipe with unusual rapidity irrespective of his distance from the instrument; to couple the various departments, manuals, pedals or pipes and to operate and control the swell-shutters in a manner and with readiness and to accomplish these ends without having to pull out or push in the more or less clumsy rods of wood furnished with knobs which have hitherto been employed, or to depress keys which offer unpleasant resistance to the touch of the finger. Novel arrangements of tremulants are also provided and are adapted to be operated by electricity or otherwise.

522,231. Auxiliary Fire Alarm Signal System. Joseph Sachs, New York, N. Y.

The present invention relates to systems in which fire alarm or street boxes can be released or operated to send their signals over a main circuit by means of one or more auxiliary or local circuits having suitable circuit-controllers and devices at a distance from the street boxes. The present invention constitutes an improvement on a former patent.

522,232. Electric Safety Fuse. Joseph Sachs, New York, N. Y.

The inventor covers a fuse with a non-inflammable material that is a poor conductor, such as silicic acid, whereby the flash is prevented and the metal converted into a poor conductor.

522,233. Electric Arc Lamp. Albert Schweitzer, Allegheny, Pa.

The invention relates to gravity feed arc lamps and more particularly to those in which curved carbons are employed and adapted to move in the arc of a circle while in operation, and it is its purpose to overcome the labor of frequently renewing the carbons as well as the difficulty experienced in the failure of the lamps to so feed the carbon as to entirely consume it. An additional purpose of this invention is to reduce the size of arc lamps.

522,241. Alternating Current Dynamo-electric Machine. Elihu Thomson, Swampscott, Mass.

This invention relates to dynamo-electric machinery and consists in improvements in alternating current generators or motors, whereby, in the case of a generator, the periodicity of the current fed from it to the line may be varied while the machine is running at constant speed. Conversely, in the case of a motor fed from a circuit carrying currents of substantially constant periodicity the periodicity of the current received by the motor can be varied with respect to that of the line, and the speed of the motor thereby controlled and regulated. In carrying out his invention the inventor provides a commutator, the segments of which are connected in the usual manner to the respective coils of an armature of any ordinary type, and upon the commutator are placed brushes adapted to take current from it but independently revolvable, that is to say, capable of revolving with it or of revolving faster or slower with relation to it, so that they may remain constantly in contact with the same segments respectively, or may travel from one of the segments to another according to the respective rates of speed at which the armature and brushes revolve. These brushes are connected to collecting rings from which, in the case of a generator, alternating currents are collected by suitable collecting devices. If the brushes rotate at the same rate of speed as the armature, it is evident that the periodicity of the current at the collecting rings will be dependent upon the velocity of the armature just as if the coils of the armature were directly connected to the rings. If, however, the brushes were rotated at a speed greater or less than that of the armature, the rings connected to the brushes would receive impulses of current with greater or less frequency; in other words, the periodicity of the current would be modified according to the rate of rotation of the brushes. Conversely, in the case of a motor, the periodicity of the current collected at the rings is modified by the rotation of the brushes before reaching the coils of the armature. A modification of the invention is shown in the accompanying drawing.

522,242. Process of Manufacturing Insulating Material. August F. Tinnerholm and Charles F. Peterson, Schenectady, N. Y.

The inventors specify a new and improved process for manufacturing sheets of insulating material from pieces or scales of mica of the character known as scrap mica. Powdered gum or resin in a dry state is used instead of varnish, preferably in amount less than 10 per cent. of the finished plate, thus saving the loss of alcohol which occurs in other processes.

522,274. Dynamo-electric Machine. Charles E. Scribner, Chicago, Ill.

The object of the invention is to provide for automatically controlling the current strength in dynamo-electric machines, notwithstanding variations in work which is being done, and at the same time to prevent objectionable sparking at the collecting commutator. More particularly the invention consists in the construction of the field magnets and the disposition of the poles about the armature, these pole pieces having their cores so wound and connected that the short circuited coils will have a field of force of the required strength maintained practically constant, while the field of force of the current giving coils will be automatically varied in intensity to vary the electromotive force of the machine to maintain practically a constant current notwithstanding variations in the resistance of the working circuit.

522,275. Regulator for Dynamo-electric Machine. Charles E. Scribner, Chicago, Ill.

The invention relates to regulators for dynamo-electric machines, by which the brushes are automatically shifted from time to time to maintain a practically uniform current strength notwithstanding variations in the resistance of the current. A dash pot has its piston rod *a* pivoted to an arm or extension of the brush carrier *b*, this piston being weighted as shown in the drawing, the amount of weight being adjustable. The motor *c* is placed in the main circuit and upon its revolving shaft is carried the arm of striker *d*. Upon the brush carrier or connected with it is provided the bearing piece *e* against the under convex surface of which the striker *d* is brought at each revolution. Every time the striker thus takes the bearing surface the brush carrier is rotated a short distance against the force of the weight of the dash pot piston. The position which the brush carrier will occupy depends, therefore, upon the amount of weight on one side and the frequency of strikes on the other side. The weight is initially adjusted to the normal current of the machine and then the position of the brush carrier, and hence of the brushes upon the commutator, will depend upon the speed of rotation of the motor; that is, the greater the number of blows of the striker the greater will be the force opposed to the counter-balance weight of the brush carrier, and hence the brush carrier will be moved to adjust the brushes forward upon the commutator to decrease the voltage. As lamps are cut in or cut of the circuits, the resistance is increased or diminished as the case may be. Thus the rate of revolution of the motor is changed and the brushes are accordingly shifted forward or backward upon the commutator to maintain the current strength.

522,276. Electric Arc Lamp. Albert W. Smith, San Fracisco, Cal.

The main object of this invention is to produce a cheap, simple and reliable arc lamp, adapted for use with either continuous or alternating currents and adapted to operate in multiple arc from constant potential mains or transformers.

522,277. Window Spring for Burglar Alarms. Josef Stenier, Brooklyn, N. Y.

This invention relates to circuit closing switches for burglar alarm systems, particularly for switches in use in windows, generally known as window springs. Its object is to produce a window spring having its parts so arranged that it may be readily converted from a closed circuit to an open circuit instrument; that is, that it may be arranged either to close the circuit when pressed upon by the window sash, or to open the circuit when so pressed.

522,286 Dynamo-electric Machine or Motor. Charles S Bradley, Avon, N. Y.

It is the object of the improvements in this invention to render high potential electric machines of that kind in which the field magnet circuit is coupled in series relation to the armature circuit, safely operative without the necessity of adopting extraordinary precautions in the insulation. In carrying out the invention the inventor provides the machine with a plurality of armature windings coupled to independent pairs of brushes, and connects the field-magnet coil in series relation with a pair of intermediate brushes, forming a good electrical connection at some point between the intermediate brushes and the base of the machine. The result of this construction is that the frame of the machine is brought to the potential of one of the intermediate brushes and the dielectric strain upon the field-magnet and armature circuits is greatly reduced.

522,294. Electric Arc Lamp. Edward Heymann and Frank W. Heymann, Boston, Mass.

One feature of this invention, which relates to arc lamps, consists in a novel construction and arrangement of the carbon operating magnets by which a more efficient feeding of the carbons may be obtained to produce a steadier and more even light. Another feature of the invention consists of a novel construction of globe holder, by which the holder may be readily lowered from the lamp to permit of the easy replacement of the lower carbon and also of the globe itself, the supporting base for the lamp globe being preferably constructed with a discharge orifice for the carbon dust usually accumulated in the globe holder, the orifice being normally closed by a removable cap. A novel construction of the carbon and its holder is also used by which the lamp frame may be materially shortened, the carbon being preferably constructed to prevent racing of the arc, thereby obtaining a steadier light and effecting a more even consumption of the carbon.

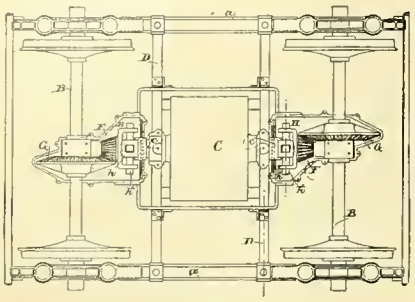
522,302. Self Locking Cleat for Electric Wires. Elias Nashold, Chicago, Ill.

The invention provides for a cleat which shall be simple and inexpensive in construction, strong and durable, and which can

be readily applied or removed from the ceiling or wall, and, in addition, such a device by means of which the wires can be readily strung or hung and, when placed in the cleats, will be locked therein and firmly retained.

522,327. Electric Arc Lamp. Jesse F. Kester, Buffalo, N. Y.

One object of this invention is to provide means by which the leverage between the magnet and the feed mechanism can be varied so that a current of larger or smaller volume or quantity can be used in connection with the lamp. Another object is to improve the construction of the feed mechanism so that the vibrations of the magnet armature will not be communicated to the feed mechanism.



NO. 522,189.

522,332. Electric Switch. John Van Vleck, New York, N. Y.

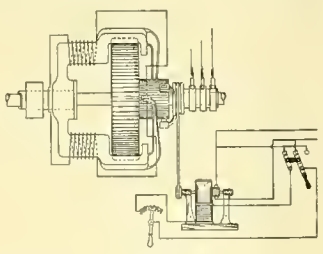
The invention is an improvement in switches designed for a three wire system, so arranged that circuit through the neutral conductor is broken after and made before it is established through the positive or negative conductors. The object of invention is to insure that the current shall never pass directly between the positive and negative wire.

522,344. Alternating Current Motor. John F. Kelley, Pittsfield, Mass.

The invention is an alternating current motor and has for its object to produce a means for practically transforming the electrical energy of a single alternating current into mechanical energy in the form of continuous rotary motion without the use of commutators or similar devices, and without the use of any modifier of the magnetic or electrical phases of the magnetic field or the exciting current or of any auxiliary circuit or starting device.

522,345. Method of Producing Continuous Motion by Alternating Currents. John F. Kelley, Pittsfield, Mass.

In the illustration of which the drawing at the left represents a perspective view of a motor, and the other a front elevation with the coils of the field magnet cut away so as to show its poles, *M* is a laminated field magnet, the pole pieces of which are brought face to face so as to leave a wedge shaped air space between them; *C* an exciting coil connected with a source of alternating current; *D* a disk of homogeneous copper or other good electrical conductor supported by a suitably mounted axis *A* so as to lie between the pole pieces and be free to rotate in a direction from one end of the wedge shaped air space toward the other. Upon the passage of an alternating current through the exciting coil *C*, the field magnet becomes energized and an alternating magnetic field of single or uniform phase is produced, the magnetic flux being from one pole to the other. By reason of the variation in the reluctance of the magnetic circuit resulting from the wedge shaped air space, the magnetic flux is greater toward the narrower part of the air space, that is, the alternating magnetic field is more strong or dense in that part, or, as may be said, the magnet, so constructed, produces when energized an asymmetrical alternating magnetic field which is to be understood to mean an alternating magnetic field in which the distribution of flux is not the same on both sides of the center of its figure. The action of the asymmetrical field upon the disk lying within it is to induce currents therein which, reacting upon the inducing field, produce motion. So far as the method is concerned, it makes no difference what the form of the inducing system or the induced system is provided only the inducing system produces an asymmetrical field of single or uniform phase while the induced system is, symmetrical so as to present an unchanging conductor for the induction of currents, and the two systems are relatively movable. It may be stated that the method consists broadly in setting up a single phase alternating asymmetrical magnetic field, and by such field inducing a current in a closed conducting system free to move, and more particularly in setting up a single phase alternating asymmetrical magnetic field, and by such field inducing a current in a symmetrically mounted conducting system mounted so as to be free to move from the weaker to the stronger part of the field and vice versa.



NO. 522,241.

522,346. Automatic Fire Alarm. Charles A. Mann, Buffalo, N. Y.

This invention relates to the class of alarms which are combined with an electric circuit, and in which the release of the alarm is controlled by an easily fused material which melts when the surrounding temperature rises to a predetermined point. The object of the inventor has been to produce an automatic fire alarm of this character which permits the ready renewal of the easily fusible part of the alarm.

522,349. Rail Joint and Bond for Electric Railways. Julius Meyer, New York, N. Y.

The object of the invention is to improve the construction of the rail bonds by making them a part of the rail joint itself and arranging them in such a manner that they are protected against injury of any character.

522,356. Alternating Current Motor. William Stanley, Jr., Pittsfield, Mass.

The inventor claims in addition to a new type of motor, the method of producing continuous motion by alternating currents which consists in producing in a field magnet by an alternating current an asymmetrical magneto-motive force of alternating polarity, by such asymmetrical magneto-motive force producing an asymmetrical alternating magnetic field, and by such field of uniform phase inducing currents in a conducting system mounted symmetrically about an axis around which either the field magnet or the conducting system is free to rotate under the action of the inducing field and the induced currents.

522,362 Suspension Clip for Trolley Wires. William F. D. Crane, East Orange, N. J.

To prevent any shock in the passage of the trolley wheel from the wire to the under side of the clip, the hooks which embrace the wire upon opposite sides are connected by a thin spiral edge of metal adapted to form a gradually increasing area of contact between the wheel and the clip. To permit the application of the clip to a wire under tension, the body of the clip and the upper surfaces of the hooks at the ends of the same are so sloped that a suitable pressure of the under hook upon the wire suffices to spring the wire automatically into engagement with the hooks.

522 370. Distributing Board for Electric Circuits. Reinold Herman, Crafton, Pa.

The invention has for its object a construction wherein the main and distributing wires may be readily attached to their terminals and the distributing circuits, in any desired number, connected to the terminals of the main circuits by fuse strips.

522 374. Electric Railway Supply Circuit. Rudolph M. Hunter, Philadelphia Pa.

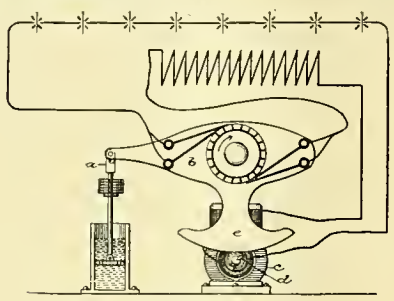
A suitable system of circuits is described for supplying electricity to the working conductors of two or more electric railways which shall involve the least expenditure of capital in the permanent equipment of the road.

522 388. Electric Railway Switch and Trolley. Frederick S. Perrio, Lynn, Mass.

In accordance with this invention the trolley wire is provided with one or more switches, by which the trolley wheel may be diverted from one trolley wire to another or branch trolley wire, the trolley wire switches being under control of the operator on the car.

522,404. Telephone Transmitter. William R. Cole, Detroit, Mich.

In the operation of the instrument described in the patent and illustrated in the accompanying drawing, the bar *D* maintains the platinum point in contact with the diaphragm and the bar *L* maintains the contact between the electrode and the platinum point, but the vibrations of the diaphragm cause a variation of pressure between them, which produces the undulation in the transmitting circuit. It will be seen that the varying pressures of the diaphragm against the bar *L*, produce corresponding variations of pressure against the button *M*, but these variations in pressure are greatly amplified by the action of the lever *I*, which is caused to oscillate on its fulcrum on account of the elongation, and contraction of the bar *D*, which causes the bar *L* and electrode *M* to bring varying pressures to bear against the contact *G*, thereby proportionately increasing or diminishing the variations in pressure between the contacts *G* and *M*. Intensity of vocal sounds and absence of foreign vibrations is claimed by this patent.



NO. 522,275.

522,428. Insulator. Romaine Mace, New York, N. Y.

One of the claims of this patent reads:

A tubular insulator located in an opening in a timber or support, in combination with a fastening device surrounding one end of the insulator, and one or more screws or nails passing therethrough into the timber or support.

522,431. Electric Alarm Signal for Railway Crossings. James J. Ross, Detroit, Mich.

The invention consists in the peculiar arrangement and combination of electrical appliances controlled by a train in passing a crossing with an electric alarm bell located at the crossing, whereby the appliances control the proper ringing of the bell by opening and closing suitable breaks in the circuit of the bell.

522,440. Conduit Electric Railway. John H. Tyrrell, New York, N. Y.

The invention relates to improvements in that class of electric railways in which the main conductor or line wire is arranged in a conduit beneath the roadbed; and the object of it is to produce a railway of this class having the conduit constructed and arranged in such a manner that easy contact may be made with the line wire, and that the line wire may be perfectly protected and insulated, also to provide means for easily shifting the trolley from side to side, and further, to construct the apparatus so that the trolley may be easily disconnected, and that at the same time the brakes may be applied, thus enabling the car to be easily stopped.

522,454. Machine for Teaching Telegraphy. Thomas M. Crepar, Clare, Mich.

A machine is described adapted for use in teaching telegraphy which may be adjusted so as to make it of greater or less capacity.

522,460. Electric Railway Conduit. Albert F. Fay, Minneapolis, Minn.

This invention consists in the combination with the rails and the ties upon which they rest of stringers or beams resting upon the ties, the space above being closed by surface plates so arranged as to leave a continuous slot for the accommodation of a trolley arm. Beneath the ties and midway between the rails is provided an artificial stone trough, the upper walls of which extend upward between the several ties and, join with the under sides of the stringers, thereby leaving an opening between each two ties, and of a width equal to the distance between the inner walls of the trough or the lower part of the conduit.

522 461. Conduit Trolley Arm. Albert F. Fay, Minneapolis, Minn.

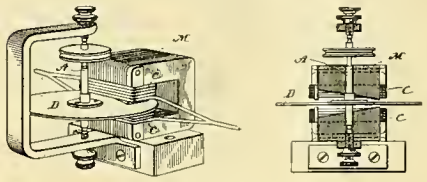
The idea is to provide in that part of the arm above the surface of the road a section of metal which is weaker than that composing the remainder of the arm whereby any considerable lateral movement of the car or the strain on the arm will cause the arm to part at that point, leaving the trolley in the conduit and preventing the tearing up of the surface plates belonging to the conduit, as well as all damage to any of the electrical apparatus upon the motor car.

522,473. Torpedo Machine or Apparatus for Railway Signaling. Jacob W. Lattig, Easton, Pa.

The machine which the inventor has devised relates to apparatus whereby under certain conditions a torpedo is exploded by a passing train, and is electrically controlled, the hammer or striking part by which the torpedo is exploded being controlled by an electro-magnet, through the intermediary of which the hammer will be called into play or not, by the action of the passing train, according as the magnet is de-energized or energized.

522,479. Electrode for Secondary Batteries. William Morrison, Des Moines, Ia.

The object of the invention is to so construct a battery plate that the utmost extent of surface is presented to the action of the electrolyte in the operation of the battery, which plate may be formed with the utmost facility and readiness, and which shall also be of such a character as to prevent free expansion in the charge, and thus prevent the injurious effects incident to warping and buckling, and which shall be firmly and securely bound and held together in such a manner as that the parts thereof resist all tendency to separate under the charge.



NO. 522,345.

522,500. Telegraph Repeater. Alfred D. P. Weaver, Jackson, Miss.

The invention relates to telegraphic repeaters or instruments used to cause a message coming over one line to be repeated or transmitted over another line without the aid of an intermediate operator. The object is to cheapen and simplify the instrument, to reduce the number of connections, to enable it to be more easily understood by inexperienced operators, to economize the local batteries, to reduce its liability to fail in operation, and to avoid the mutilation of signals.

522 506. Electric Converter. George D. Burton, Boston, Mass., and Edwin E. Angell, Somerville, Mass.

This invention relates to a converter especially designed for transforming electric currents of small volume and high pressure into currents of low pressure and large volume for metal heating purposes. The objects are to secure simplicity of construction and facility in varying the secondary current.

522,507. Electric Converter. George D. Burton, Boston, Mass., and Edwin E. Angell, Somerville, Mass.

The object of the invention is to provide a converter to which a number of electric forges are connected in parallel with means for regulating the secondary currents for the several forges either jointly or independently of each other, so that the workmen at the different forges can readily adapt the heating currents to the size of the bars being heated.

522,527. Electric Automatic Circuit Breaker. Carl W. Larson, Lynn, Mass.

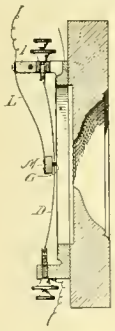
It is the purpose of this invention to describe improvements in electric automatic circuit breakers for the purpose of automatically breaking the line circuit of electric motors when overloaded, and thereby preventing the wire of the armature from being burned out.

522,528. Electric Torpedo Apparatus and System for Railway Signaling. Jacob W. Lattig, Easton, Pa.

The inventor claims the combination with the track circuit and track relay included therein, a torpedo apparatus having a break in its exploding mechanism, an electro-magnet for controlling the break, and a circuit including the torpedo magnet and completed through contacts controlled by the track relay, of a branch or auxiliary circuit also including the torpedo magnet, a torpedo track section, and connections whereby, by and during the passage of a train over the torpedo track section, the branch or auxiliary circuit is put in condition to cause the torpedo magnet to maintain or restore, as the case may be, the break in the torpedo exploding mechanism.

522,559. Galvanic Battery. Franz Fuller, Chicago, Ill.

A galvanic battery is described consisting of a zinc element in a solution of potash, the proportions being, substantially, one pound of potash to seven quarts of water, and a carbon element in a porous cup containing a solution of sulphuric acid and nitrate of soda, the proportions being, substantially, four parts of sulphuric acid, three parts of water and one part nitrate of soda.



NO. 522 464.

522,564. Multiple Telephony. Maurice Hutin and Maurice Leblanc, Paris, France.

The invention is based principally upon the following facts and considerations. Over a line having a given coefficient of self induction and a given static capacity, alternating currents of only a certain definite frequency can be passed without suffering undue diminution of volume, while currents of all other frequencies are weakened to such extent that they are practically of no value. It is, therefore, possible to so adjust the coefficient of self induction and the static capacity of a line that only alternating currents of a desired frequency can be passed over the same for practical purposes. The invention has reference to improvements in the art of telephony, its object being to transmit between two or more central stations connected by a single line or network of connected lines, telephonic messages simultaneously in all directions without interference with each other. By an extension or amplification of the system the inventors are also enabled to establish simultaneously telephonic intercommunication between the subscribers whose lines terminate at the different central stations.

Western Electrician.

EVERY SATURDAY.

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## The Measurement of Electric Current for Domestic and Other Uses.

It is one of the inalienable rights of man to grumble at the meter. The stove-pipe and the gas meter have perhaps headed the list of inanimate objects upon whose shoulders must rest the responsibility of much profanity, and which, if the doctrine of vicarious atonement may be extended to things without life, must suffer, if such can suffer, the torments of the damned in the kingdom come.

There are those who believe in a coming millennium, but from the meter standpoint its rapidity of approach must be regarded as a negative quantity, for if the vilification and hard words of which the meter has been the innocent cause is measured by the number and kinds of meters, this looked for millennium must be revolving in a parabolic or hyperbolic orbit and had its perigee before the advent of meters and is now passing out into interplanetary space like the non-periodic comets, never to return to this mundane sphere. For did we not begin with the gas meter, and was this not followed by the water meter, and these two by the electric meter, and does this latter not promise to be the most robust of all? And if these evil geniuses, upon which both severally and collectively we have hurled anathema, be thus rapidly increasing both in number and in kind, where is the hope of the millennium?

In the city of New York alone there are over 200,000 incandescent lamps of 16 candle power, 2,700 arc lamps and over 6,000 horse power of electric motors, the current for all of which is charged against the customer by this mendacious inaminate liar—the electric meter.

There are in New York city alone 5,500 of these meters representing as many customers, large and small, and nobody knows how many thousands elsewhere, each of which tells its tale of woe monthly. If the gas or water meter which measures things tangible, palpable and ponderable, is little understood, and for that reason more than any other under suspicion, it is more than natural perhaps that the electric meter which measures that mysterious something, which indeed, we are pretty sure was not a thing at all, should be convicted without a hearing—the more so because after we have enjoyed its sensible benefits for a month it has left no visible record by which we may figure out our own bills.

It may not be uninteresting, therefore, to trace it to its lair and see not only how this mysterious instrument is constructed, but also how its record is read, and the precautions taken against error in this record and the falsification of its returns.

Although there are three enormous Edison central stations in New York, furnishing light and power from the Battery to the Harlem river, each in a sense being a separate organization with its own individual customers, the meters of all are read each month at the Pearl street station and the bills for all are there made out.

It must be understood at the outset that although we do not know exactly or perhaps even approximately what electricity is, its properties are well understood and the things which it can do have been well studied and found to conform to well defined laws. By measuring the things it can do, therefore, we have a most definite yardstick for the electricity itself. One of the earliest discovered useful characteristics of the electric current was its ability to deposit metals from solution (electroplating). If, for instance, we immerse the object to be electroplated in a solution of gold and cause an electric current to pass from one electrode through the solution to the object, and thence out of the liquid to the outer circuit, the gold in the solution will be gradually deposited on the object, and this deposit will be at a definite rate for a definite current until the solution is exhausted of its metal. If, however, the electrode by which the current enters the gold solution be itself of pure gold the action of the current will be to cause a transfer of the metal of the entering electrode, through the solution, to the object being plated—that is to say, the gold electrode will be dissolved as fast as gold is deposited from the solution, and the latter is therefore not impoverished by the operation.

Now, since as much metal goes into solution from the one metal as is deposited upon the other, either the gain in weight in one or the loss in the other might serve as a measure of the current passing, and the two might be used as a check the one upon the other. This is the principle of the Edison meter, which from the manner of its action as here outlined, is called an electrolytic meter. It consists simply of a glass bottle, shown in Fig. 2, with a watertight stopper, filled with a solution of sulphate of zinc, in which is immersed two plates of zinc whose terminals pass up through the stopper. Through one of these plates the current is carried into the solution and through the other it is carried out. As the current passes, a proportionate amount of zinc is dissoved from the one and an equal portion separated from the solution is electroplated upon the other, the solution in the meantime remaining, even after long con-

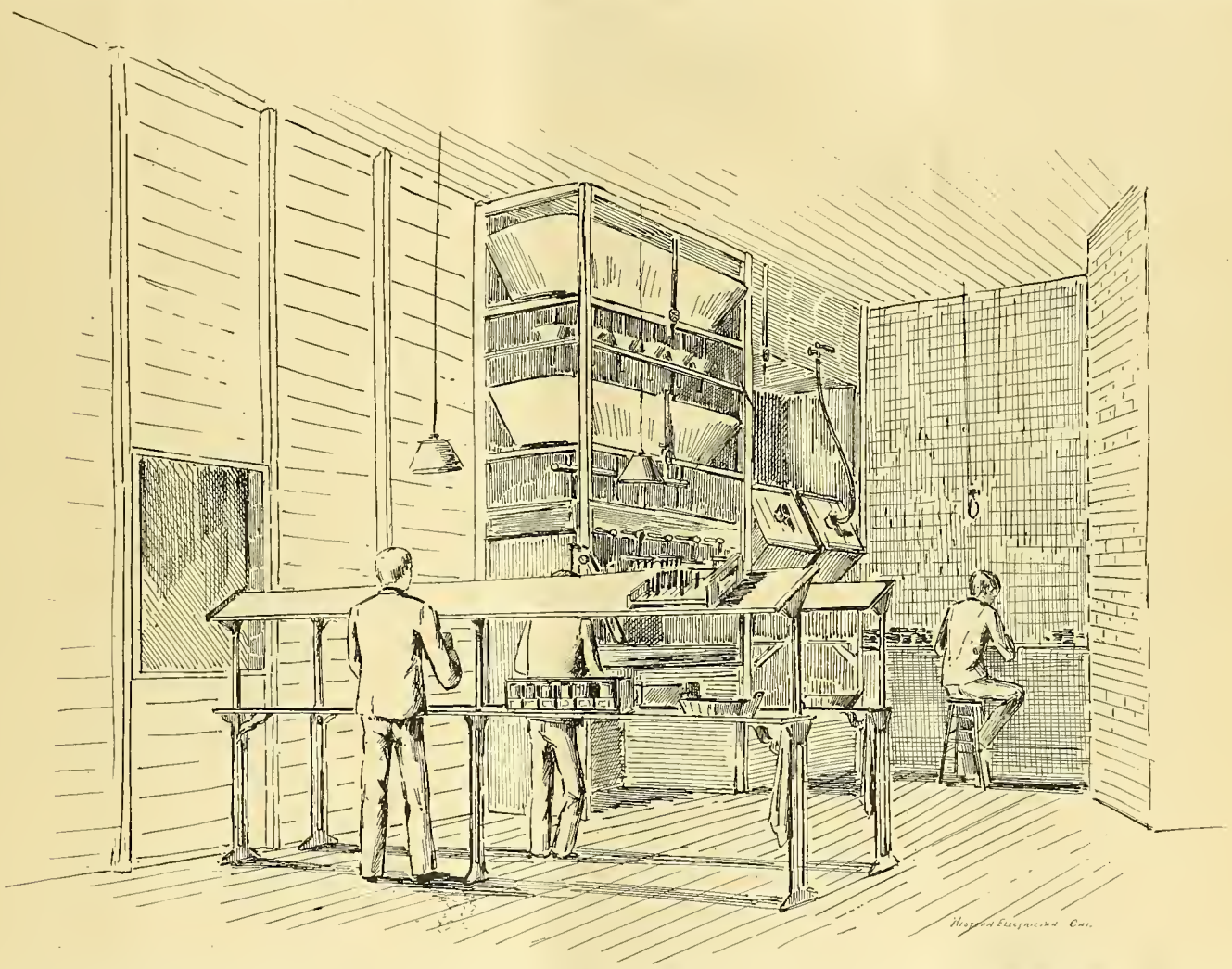

FIG. 1. THE MEASUREMENT OF ELECTRIC CURRENT FOR DOMESTIC AND OTHER USES.—ASSEMBLER'S DESK; SOLUTION AND ZINC CLEANING DEPARTMENT IN BACKGROUND.

tinued action of the current at its normal strength.

It has been found by experiment that 1 ampere of current will deposit exactly 1,224 grammes of metallic zinc in one hour. If, therefore, we pass an unknown quantity of electricity through one of these bottles for an unknown period of time, and then upon weighing the zincs carefully, find that one has gained 1.224 grammes or the other one lost that weight, we know that the equivalent of one ampere has been flowing for the equivalent of an hour. This unit —one ampere for one hour—is termed an ampere hour for the sake of perspicuity, and may mean the flow of half an ampere for two hours or a quarter of an ampere of four hours, or four amperes for a quarter of an hour. It matters not into what factors the unit be divided, provided only their product is unity.

If, however, the whole of the current to be measured were passed through the bottle, the whole of its energy would be consumed in the deposit of zinc and there would be none left for useful purposes. The method adopted in the Edison meter is therefore to measure only some small fractional part of the current, allowing the remainder to pass on around the bottles to do the work required.

The selection of this fractional part to be measured depends upon the electrical law that where two or more paths are open to an electric current it will divide itself up among those paths according to their relative conductivities. Thus, if there are two paths of equal conductivity, each will carry exactly half the current; if one of the two paths has but half the conductivity of the other it will carry as its share but one-third the total current, while the other will carry two-thirds. Thus, it is easy to proportion the conductivities of the two paths so that the one of higher resistance, which is the one which carries the portion to be measured, will carry only the fraction of the total desired. In the Edison meter the relative conductivities of the two paths are such that the bottle circuit, namely that carrying the fraction to be measured takes about $\frac{1}{1000}$ part of the whole current, or to be more exact, $\frac{1}{975}$ part. This portion goes through the bottles, and is sacrificed by the company for the sake of getting a record of the consumption of energy by each customer. Of course, if only $\frac{1}{1000}$ part of the current is measured the readings of the meter must be multiplied by 1,000 to give the total energy consumed.

It will be apparent that since the amount of current which will take either path depends upon the relative conductivities of those paths it is necessary that if the bottle circuit is to carry just $\frac{1}{1000}$ part of the current—no more, no less—at all times, its conductivity must be maintained exactly constant at all times. There is no difficulty in keeping the conductivity of the other path constant, for that path may be made as large as desired, so as not to be heated perceptibly by any current it is intended to carry, but the bottle circuit, which is of fine wire, presents difficulties which must be overcome. In the first place the conductivity in the bottle will vary either if the strength of the solution varies or if the distance between zincs varies For this reason the zincs in each bottle are kept a uniform distance apart by two buttons placed between them and held in position by bolts passing through them and fastened by nuts on the outside, and the solution is carefully standardized before being introduced into the bottle.

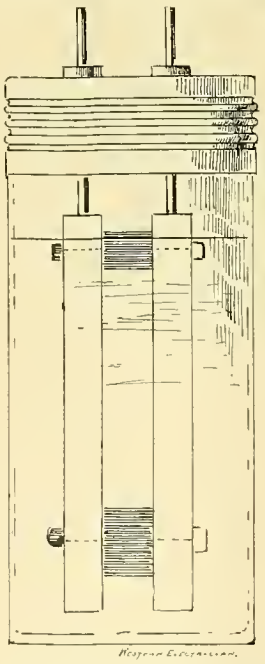

FIG. 2. THE MEASUREMENT OF ELECTRIC CURRENT FOR DOMESTIC AND OTHER USES.—METER BOTTLE.

Two other difficulties have to be met in the bottle circuit in order that its conductivity may be maintained constant. Whenever a current of electricity passes through a conductor, be it liquid or solid, it raises its temperature. When a liquid is heated its conductivity is increased, but when a solid is heated its conductivity is decreased. There are a few exceptions to this rule, but copper is not one of them. Since we have both copper and liquid in this bottle circuit and the effect of heat upon the two is opposite in kind, it is possible by means of nice calculation to make the two effects exactly balance each other. This method of compensation is adopted in the Edison meter by introducing into the bottle circuit a spool of fine insulated wire Fig. 3.

In the No. 2 meter, which has a capacity for 25 lights, a spool of No. 32 copper wire, having a resistance of 16 ohms, is found to produce exact compensation.

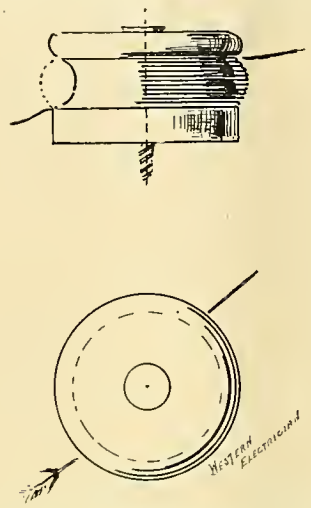

FIG. 3. THE MEASUREMENT OF ELECTRIC CURRENT FOR DOMESTIC AND OTHER USES.—COMPENSATING SPOOLS.

On account of the fact that according to an electrical law one of the zincs must lose what the other gains, and because of the several features of the bottle circuit that are liable to variation as just explained, it is extremely desirable that there be some check on the record and readings of the meter. If, therefore, a second meter bottle be arranged along side of the first so connected to the bottle circuit as to receive exactly the same amount of current as the first and to operate under identical conditions of temperature, etc., as the first, a disparity in the records of the two would at once indicate an error in either one or both and a concordance between the two be equally strong evidence of the correctness of both. A mistaken record under these conditions could go undetected only when an exactly equal error occurred in both bottle circuits, which is an exceedingly unlikely occurrence. In the Edison meter, Fig. 4, what has thus far been called the bottle circuit and of which it has been said that its conductivity was so proportioned as to take off but $\frac{1}{1000}$ part of the whole current for measurement, is made a little larger so as to take off $\frac{1}{500}$ part of the whole current. Two meter bottles are used instead of one and the circuit is divided before it reaches the bottles into two branches, each of which has its own compensating spool and each leads to its own bottle, and each branch in its entirety has exactly the same conductivity as the other, so that each will carry just one-half of the $\frac{1}{500}$ part of the current taken off to be measured, Each bottle will therefore measure just $\frac{1}{1000}$ of this current as before, and if there be no unequal disturbing causes, both bottles will register exactly the same.

It will be evident that since in each bottle there are two plates of zinc, one of which loses in weight by the passage of the current and the other gains, there is the possibility in the two bottles of four checks on the reading of the meter; that if everything has worked properly the two losing zincs must have lost an equal amount, and this loss must exactly equal the gain in weight of the other two.

But in practice this quadruple check is not considered necessary and only a double check is used. This consists in weighing the losing plate of one bottle and the gaining plate of the other. The amount lost by the first and that gained by the second should of course correspond. They will not, however, if the solutions in both bottles are not of the same strength; if the distances between the pairs of zincs in both bottles are not exactly equal; if the temperature of one bottle is higher than the other or if the two compensating coils fail to compensate to the same degree, or if any other causes are active affecting one bottle more than the other.

There is another point that must be explained before proceeding further. In the Edison system of electrical distribution what is called the three wire system is almost universally employed. This three wire system may be sufficiently explained for present purposes as consisting of two complete circuits, which instead of using two wires each, use one wire in common. On account of the peculiar arrangement of the circuits which, need not be explained here, the greatest economical advantage is gained when the lights in each of the two circuits using in common the third wire are exactly equal in number and symmetrically arranged with regard to the neutral wire. For this reason every Edison circuit from the dynamo to its farther end consists really of two circuits of three wires, and the three wires are led into each customer's house. Each customer's house has therefore two circuits and the number of lamps installed in each house is equally divided between these two circuits.

Now, although in installing the lamps in a house provision is made for an equal consumption from both of these circuits, the consumer doesn't know on which circuit the various lamps are connected, and if he did it would make no difference with him; he would use those lamps which were most convenient. The consumption of current from the two circuits in a given house will therefore never, except by the merest accident, be the same, so that it must be measured in each separately. Therefore, the two-bottle meter just described is duplicated, two bottles being used to measure the current of one circuit and two being used for the other, so that the Edison meter as installed consists of four bottles enclosed in a metallic case for mechanical protection and locked to prevent tampering.

Interesting as is this method of recording the consumption of current, the methods of reading the records and interpreting them, is perhaps still more so. This is all done at the Pearl street station, which is probably the largest metering station in the world. To understand the business methods employed let us start with the meter before it is put together in the Pearl street station and follow it through its course until it comes back again to be read and the bills are made out.

The zinc plates as they come from the casting-room or from previous use are first scraped or filed to remove all dirt and to give them a bright, clean surface, Fig. 5. They are then dipped in dilute sulphuric acid and then in mercury, which causes a thin coating of the latter to adhere over the whole surface, any excess of mercury being carefully wiped off. This process is termed amalgamation, its effect being to cause more uniform action of the current when the zincs are placed in the meter. The stems by which the plates are connected to the circuit when in the meter are also polished and the zincs are then taken to the weighing room, Fig 6. Along one side of this at one end are a series of shelves divided vertically into three compartments. These three compartments are severally labelled "Outgoing plates to be weighed," "Outgoing plates weighed" and "Outgoing plates check-weighed." The cleaned zincs are placed in the compartment marked "Outgoing plates to be weighed."

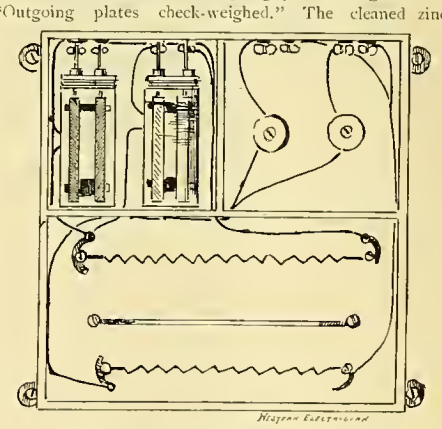

FIG. 4. THE MEASUREMENT OF ELECTRIC CURRENT FOR DOMESTIC AND OTHER USES.—DETAILS OF HOUSE METER.

In the weighing room there are six Becker chemical balances, so delicate in their operation as to indicate the weight of an inch length of human hair almost as readily as an apothecary's balance will indicate the weight of an ounce of medicine. Each of these balances is presided over by a young lady who does the weighing. Supposing a new meter is to be made, a card bearing the number of the meter and the rack into which it is to go, the number of the customer, size of plate and number of the plate, is made out in the office and given to one of these girls, who, taking one of the zincs before mentioned, weighs it carefully, marks the weight of the plate and number of the meter and the letter A, B, C or D by which the particular zinc will be specified when placed in the meter, with lead pencil on the zinc itself, and also makes the record on the card, to which she adds her own initials. This done

she places the zinc with the card in the shelf compartment labelled "Outgoing zincs weighed." from which it is taken by another girl who weighs it again, and if the first weighing is found correct, puts her initials on the card in the proper column, and places both zinc and card in the compartment marked "Outgoing zincs check-weighed." It may be stated here that since but two zincs—a losing and a gaining zinc in each meter of two bottles—are taken for record, the weighers always handle the zincs in pairs, marking each appropriately so that it will be identified either as intended for a gaining or a losing zinc. The card before mentioned always accompanies the two pairs of zincs, which go to make up a four-bottle meter.

From its last resting place the zincs go out into another room to a man called the "comparer," Fig. 7, who examines every plate and sees that all plates are in the same order as the record; also if there is a difference between the weighing and the check-weighing. If there is a difference the plates are sent back for reweighing.

It is the practice of the company to overlook a mistake if it be in the first weighing, but if it be in the check-weighing the person responsible for it is discharged. This rule extends throughout the system—an error in first inspection being forgiven, but on check-inspection not.

The comparer is a further check. He makes a record in a book of all the outgoing plates, their date, number, rack number, etc., and sees that the plates passing through his hands are arranged in geographical order. He always works one day's trip ahead, and at night the zincs which the comparer has examined are placed on the assembler's table Fig. 1, to be ready for him the first thing in the morning to put together with the other zincs in the bottles to form complete meters.

It may be stated here that the collection of meters for record goes on continually, a certain number being collected and replaced each day of the month, so that the metering department is never idle.

The solution of zinc sulphate for the meters is made with icewater on account of its great purity, and is standardized every morning. The strength employed has a specific gravity of 1,054 at 60° F. From the standardizing tank it is pumped into another tank near the ceiling, from which it filters into a third from which the bottles are filled directly by a boy.

The filled bottles are carried to the assembler's tables where the zincs are put in and the bottles sealed. The four bottles which go to make up a complete meter are then placed in a rack which consists of a small box having four compartments—one for each bottle. They are not put in haphazard, but each bottle is designated by a letter, A and B being the bottles for one of the two circuits before referred to, and C and D being those intended for the other circuit. The bottles are all placed in these racks in a given orders, that being the same which they are to occupy in the meter box. Into a receptacle on the end of each rack is slipped a small card, on one side of which are blanks for the following: Outgoing trip No.——, address, name (of customer), size, number and location of meter (in customer's house). Size of bottles: A, B, assembled by——, checked by——. C, D, assembled by——, checked by——, date——.

The reverse side of the card has the printed form: Incoming trip No.——, meter No.——. Bottles changed and meter sealed. Date——, by——. No. of meter same as card; size of meter same as card; meter sealed; remarks:

These racks, each containing four bottles, are then taken into another room, where they are assorted according to the size of the bottles and placed in crates, Fig. 8, arranged in geographical order. Here they undergo another inspection, first, to see if the number of the card on the rack corresponds with the number on the bottles; second, to see if the bottles are water-tight. To test this, bottles A, B, C and D are successively taken out of the rack and inverted. If all right the inspector stamps his name and the date on the card. If anything is wrong, the rack is pulled a little ways out from the crate and left so, and when the inspection is finished the assembler is called, who corrects the errors.

If everything is right the crates are taken to the wagon which goes over a prescribed route. At each house the new bottles A, B, C and D, are successively exchanged for the old ones in the meter box; the latter replacing the former each in its proper compartment of the rack. The card on the rack is reversed and the proper entries made on the "Incoming Trip" side and the initials of the distributor stamped thereon.

On returning to the station the bottles are first dis-assembled and the two plates of each pair of bottles which are to be weighed, after being tied together, are taken to the weighing room and placed in a compartment marked "Incoming plates to be weighed." Together with each of these pairs of plates, goes a card bearing the dis-assembler's initials, together with the rack card bearing the "incoming plate" record before referred to.

The lead pencil marks which were placed on the zincs before they went out, instead of having become obliterated by a month's action of the current have become really very much more distinct and the old weighings and other marks are readily discernible. These zincs are weighed and check-weighed and the records placed upon the same card upon which the original weighings were placed. This is known as the "Record Card."

The plates and cards next go to the comparer again, who examines them as before and makes a record in the "Incoming Plate Record Book." If any mistake is found, the

FIG. 5. THE MEASUREMENT OF ELECTRIC CURRENT FOR DOMESTIC AND OTHER USES.—CLEANING THE ZINCS.

plates go back to the dis-assembler; if not, the record card goes out for calculation. No real calculation is done, for tables have been prepared for all possible cases, and reference to these gives the final results in dollars and cents. These references are made twice as a check, the record and initials of both calculators being placed on the record card, of course.

What is known as the "bill constant," which enters into the calculation of these tables, is arrived at in this way:

One ampere hour of current flowing through the meter bottle will deposit 1.224 grammes of zinc on one plate or dissolve it from another. $\frac{1}{9775}$ of the total current used by the consumer has passed through each of the meter bottles. Therefore for every ampere hour of current used by the consumer the zincs will have gained or lost $1.\frac{2224}{9775}$ grammes of zinc, or to put it in another way, for every $1\frac{2224}{9775}$ grammes of zinc gained or lost by the plates, the consumer has used 1 ampere hour of current.

Current is sold in lamp hours, namely, the number of hours a lamp has been burning. For a 16 candle power lamp, which consumes .424 ampere, the charge is 1 cent per lamp hour. Without following out the calculation further, the result is stated in dollars per gramme of zinc deposited or dissolved.

It figures out just $18.75 per gramme. Thus if we have a table calculated in this way, beginning with very small fractions of a gramme and extending upward through successive steps to grammes and over, the customer's bill may be read off directly from the table as soon as the gain or loss in his meter zincs is known.

The record card now goes to an examiner, who scrutinizes it most carefully and makes another book record, at the same time marking on the card the page of the book record. If incongruities of any kind are found, the record card and zincs are handed to the final scrutineer, who examines both the plates and the records to discover if possible the cause of the discordance. If an error is discovered which cannot be corrected, such as would be the case where the meters had very evidently been tampered with, become broken, or given wrong results through getting wet, a bill is estimated from past months' records and marked E. B. (estimated bill). E. B. is also stamped on the record card. Should this not prove satisfactory to the consumer, sometimes a week's reading is taken on a new meter and the month's bill made out on the basis of the results obtained. Such a bill is marked P. R. (prorated estimated bill). The record card is also so marked in this case, but should the discordance be less serious, as for instance, it be discovered that the D bottle works low, an inspection may show that the clip or connection was dirty. Whatever the inspection develops as the cause a record is made both on the record card and in the proper book, as follows. "Inspection ordered on date. Inspection made, date. Inspector's name. Report (dirty clip). Date remedied and how (cleaned). Thus the record card contains in brief a full record of each customer's meter, together with references to the fuller book records, so that when a complaint comes in the record card is called for and presents the whole story without further reference, and if a mistake is blamable to any employe it is directly traceable to the guilty party.

Since every operation is checked, and the results compared and inspected before the bill goes out, there is almost an impossibility of error in the office, and if such should occur it is traceable to its source as before stated.

Thirty-three employes attend to the whole of the business connected with these 5,500 meters, and so perfect is the system that there is neither clash nor confusion.

Now as to the accuracy of this meter. Under laboratory conditions where it can be properly cared for and watched and can work under the most favorable auspices it will give very accurate results. It must be remembered, however, that in actual use the most favorable conditions do not prevail. The meter is left alone for a month, perhaps in a damp cellar or where there is dust or perhaps dripping water or corrosive gases. It is not usually touched from the time the bottles are introduced into the meter box until they are replaced by new ones a month later. Under these conditions, viz., the ordinary conditions of working, the maximum error does not exceed two per cent.

Another point must be emphasized, however, namely that the meter reads highest when it is new and clean and working under the most favorable conditions. As these conditions are departed from it reads lower, that is, in favor of the customer and against the company. Water alone will make it read too high, and the meter cases are so constructed as to prevent, as far as possible, the entrance of water, but should it enter and cause a high reading the error will be discovered at once at the office.

The meter does lie, therefore, although always in our favor, but to lie for us is no sin, whereas to lie against us would be criminal.

## Rapid Transit in Boston.

The Boston rapid transit railroad law is to be voted upon July 24th, and the decision of approval or rejection will be final. The bill passed by the legislature provides for an elevated and an underground railroad. It provides for the construction of elevated railroads, either the Meigs or some other, except those of the ordinary type like those in New York, from Charlestown to Dorchester, by way of Dock square, Congress and Federal streets and Dorchester avenue; from Somerville to West Roxbury, by way of Dock square, Devonshire street, Chauncy street, Harrison avenue and Washington street; from Cambridge to Jamaica Plain, by way of Charles street, Park square and Tremont street. This is the Meigs plan, with certain extensions to South Boston, Brookline and points on the northern side of the city. The city is empowered to construct subways or tunnels from the junction of Tremont street and Shawmut avenue to Causeway street, and to acquire a strip of land from the southern entrance of the subway or tunnel to Franklin Park, and to build a bridge over the Charles river, to be used in conjunction with this municipal rapid transit system. The use of electricity as a motive power is favored.

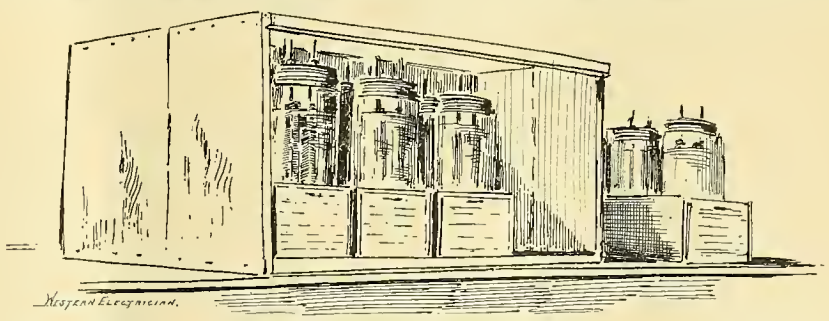

FIG. 8. THE MEASUREMENT OF ELECTRIC CURRENT FOR DOMESTIC AND OTHER USES.—A CRATE OF METER RACKS.

The proposed trolley road from Pottstown, Pa., to Reading has secured an entrance to the latter city.

# Resonance Analysis of Alternating and Polyphase Currents.[1]

By M. I. Pupin, Ph. D.

## I. INTRODUCTION.

The presence of upper harmonics in an alternating current wave is a fact which deserves careful consideration, both on account of the purely scientific interest which is attached to it, and also on account of the technical bearing of electrical resonance upon the construction of conductors possessing appreciable distributed capacity.

That alternating current and electromotive force waves of a great variety of forms can be produced by properly designing the pole pieces of the field magnet and the iron core of the armature of an alternator is a fact nearly as old as the discovery of electro-magnetic induction. Fully as old is also the knowledge that a great variety of alternating current and electromotive force waves can be obtained by means of the induction of an intermittent current.

A careful investigation of these waves was first made more than forty years ago by Lenz[2] and Koosen,[3] who employed alternators with iron in the armature. They plotted these waves from the instantaneous values of current and electromotive force obtained by means of the now well-known revolving sliding contact. Employing the same method of investigation Joubert[4] showed in 1880 that the electromotive force wave obtained from an eight pole Siemens alternator without iron in the armature is very nearly a pure sine wave. The method is now known as Joubert's method of sliding contact. In 1888 Dr. L. Duncan[5] showed how successfully this method could be employed in the study of alternating current waves produced by commercial machines in actual operation. The same method was considerably elaborated by Professor H. J. Ryan[6] in an investigation of the action of transformers. The name "indicator diagram," has been applied to wave curves of current and electromotive force obtained by Joubert's method, and very properly, I think, because they do very clearly indicate the action of alternating current apparatus. The process of taking these indicator diagrams has been shortened very much by Dr. L. Duncan's four dynamometer method.

Our knowledge of the action of alternating current apparatus has been extended considerably by these indicator diagrams.

For instance, we are now much more certain of the limitations which must be imposed upon the simple harmonic wave theory of alternating currents than we were a few years ago, and it looks very much as if progress in this direction, even more than in any other, meant progress towards a complete theory of the working of alternating current apparatus. Hence the desirability of as large a number of workers in this particular region of electrical research as possible.

There is no doubt that a simpler method would increase this number, for though much must be said in favor of the sliding contact method of obtaining indicator diagrams, yet it must also be acknowledged that the method is a very laborious and uninteresting process of investigation. A great many attempts have been made to devise some optical or some automatic method, but with little success. There is another reason why a new method of studying alternating current waves seems desirable. It is this: The method of sliding contact is not sufficiently sensitive to detect small deviations from a true sine wave, and consequently it is not capable of following up the causes of these deviations, when the effects seem to be absent. For instance, the primary current of a transformer can differ very much from a true sine form when the secondary circuit is open, but when a large current is flowing through an approximately non-self-inductive secondary circuit, then the primary can be made to differ inappreciably from a true sine wave. The question arises now, what has become of these causes when the secondary carries a heavy load?

This question is of deep scientific interest; it is also of considerable technical importance, for, if these causes are present at all loads, and only hidden by the principal wave, then, considering that these hidden small causes can produce large effects when conditions favoring resonance arise, it is evident that they must be carefully watched and guarded against in the construction of long lines possessing distributed capacity. I do not think that indicator diagrams obtained by the method of sliding contact are capable of giving a definite answer to this important question.

FIG. 7. THE MEASUREMENT OF ELECTRIC CURRENT FOR DOMESTIC AND OTHER USES—THE COMPARER.

The method of analyzing alternating current waves by electrical resonance which I employed in the following investigation was suggested by me a year ago.[1] It is the object of this paper to describe this method at some length, and to illustrate, by some of the more definite results so far obtained, the simplicity, sensitiveness and reliability of the method. I shall also point out that this method of resonance analysis works quite satisfactorily even in those cases already alluded to where the sliding contact method would in all probability fail.

## II. DESCRIPTION OF THE METHOD.

Consider the following arrangement of circuits: A non-self-inductive resistance *ab* Fig. 1A is inserted in the circuit of an alternator *A* and the primary *B* of a transformer. In shunt with *ab* is a circuit, *a*, *c*, *d*, *b*, consisting of an inertia coil *c*, of a large number of turns of copper wire of low resistance, about 10 ohms, but containing no iron, and a condenser *d*, divided into subdivisions ranging from .001 microfarad up. In shunt with the condenser *d* is an electrostatic voltmeter *e*. The self-induction of the coil *c* can be varied by throwing a larger or smaller number of its sections into the circuit. The resistance can be varied by a rheostat *f*. Suppose now that the self-induction of *c* is kept constant, and that the capacity of the condenser is gradually increased from zero up. Whenever a capacity has been reached which, with the self-induction of the circuit *a*, *c*, *d*, *f*, *b*, *a*, produces resonance with one of the harmonics in the main circuit, then the resonant rise of potential will produce a large deflection in the voltmeter. In this manner all the harmonics which are present in the current of the main circuit can be detected in the course of a few minutes. If the resonator circuit, *a*, *e*, *d*, *f*, *b*, is placed in shunt with the non-self-inductive circuit (this circuit is denoted in Fig. 1A by a line headed with asterisks and running from one pole of the alternator to the other) consisting of a bank of incandescent lamps, then the harmonics of the impressed electromotive force can be detected in the same manner. The ratio of the amplitudes of these harmonics to that of the fundamental can also be determined by this method if desirable, provided the conditions of the experiment are properly arranged. For let the current in the main circuit be

$$x = a_1 \sin pt + a_3 \sin 3\,pt + \ldots + a_a \sin a\,pt + \ldots$$

then the drop between *a* and *b* can be represented by

$$e = b_1 \sin pt + \ldots + b_a \sin a\,pt,$$

where $b_a = a_a r$,

and $r$ = ohmic resistance between *a* and *b*.

Denoting now by

$L$ the self-induction of the resonator $a\,c\,d\,f\,b\,a$,

$R$ the resistance of the resonator $a\,c\,d\,f\,b\,a$,

$C$ the capacity of the resonator $a\,c\,d\,f\,b\,a$,

then it can be easily shown[1] that the current in the resonator will be

$$y = \sum \frac{b_a}{\sqrt{a^2 p^2 \left(\frac{1}{a^2 p^2 C} - L\right)^2 + R^2}} \sin(a\,pt - \phi_a).$$

If, therefore, the capacity $C$ is adjusted in such a way that

$$\frac{1}{a^2 p^2 C} - L = 0,$$

then the circuit will be in resonance with the harmonic of frequency $a\,p$; and if $L$ is sufficiently large and $R$ sufficiently small (two conditions which are very easily fulfilled) then the current $y$ is to within a small fraction of a per cent. given by

$$y = \frac{b_a}{R} \sin a\,pt.$$

The amplitude of the potential difference in the condenser which is measured by the volmeter $e$ is given by

$$P_a = \frac{a\,p\,L}{R} b_a.$$

In the same way we obtain for the fundamental frequency

$$P_1 = \frac{p\,L}{R} b_1.$$

Hence

$$\frac{P_a}{P_1} = a\frac{b_a}{b_1} = a\frac{a_a}{a_1}.$$

This gives the ratio of the amplitude $a_a$ of the harmonic of frequency $a\,p$ to that of the fundamental. Let $a = 5$, then,

$$\frac{1}{5}\frac{P_5}{P_1} = \frac{b_5}{b_1} = \frac{a_5}{a_1}.$$

The voltmeter readings which give $P_5$ and $P_1$ magnify that ratio five times, in the case of the fifth harmonic, and it can be easily seen that a similar relation holds true for other harmonics. This is a very desirable feature of the method, considering that the amplitudes of the upper harmonics are generally small in comparison to the amplitude of the fundamental.

When quantitatively very accurate results are desired, then a low resistance, say one ohm, should be used for the section *a b*, and an electrometer capable of giving a large deflection for about ten volts.

The principal interest, however, in the study of the distortion of alternating current waves, is centered not so much in the exact ratio of the amplitudes of the harmonics to the amplitude of the fundamental wave, as it is in the causes producing these harmonics, and the conditions which modify the effects of these causes. Hence a quantitavely less accurate arrangement will do, provided that it is very sensitive, simple and easily manageable. Such an arrangement is given in Fig. 1B.

It differs from that given in Fig. 1A in the substitution of an air core transformer coil $a'\,b'$ for the non-self-inductive resistance *a b*. The secondary of this coil forms a part of the resonator circuit. For every harmonic of the inducing current we shall have a harmonic electromotive force of the same frequency in the resonant circuit. By varying the capacity in the resonator and watching the voltmeter needle, we can tell, by the deflection of the needle, whenever we have reached the capacity which, with the self-induction of the resonator brings this circuit into resonance with one of the harmonics. A reference to Fig. 2 will explain this more clearly.

In this figure the lower horizontal row of figures refers to the two-peaked curve, the upper row refers to the dotted flat-peaked curve. The vertical column denotes the voltmeter readings in volts. Consider now the two-peaked curve. It expresses the law of variation of the voltmeter readings when the capacity of the resonator circuit is varied from 0 to 2 microfarads, the self-induction being kept constant. The readings are recorded in Table I.

The voltmeter employed in all these experiments was a Sir William Thomson's multicellular voltmeter with a range from 60 to 240 volts. The curve was obtained from a 10 horse power Fort Wayne eight pole alternator with smooth core armature feeding a 5 kilowatt Stanley transformer (closed magnetic circuit), the secondary being open. It is seen that resonance took place at .190 microfarad and 1.8 microfarad. The capacity of the inertia coil $c'$ Fig. 1B,

1. A paper presented at the eleventh general meeting of the American Institute of Electrical Engineers, Philadelphia, May 18, 1894.

2. Pogg Ann. 76 p. 494, 1849; 92 p. 123, 1854.

3. Pogg Ann. 87 p. 386, 1852.

4. *Comptes Rendus*, Vol. xci, p. 161, 1880; Ann. de l'ecole super. 10 p. 131, 1881.

5. See article by Duncan, Hutchinson and Wilkes in the *Electrical World*, March, 1888.

6. *Trans.*, vol. vii, p. 1. January, 1890.

1. M. I. Pupin, "Electrical Oscillations of Low Frequency and Their Resonants," *American Journal of Science*, vol. xlv., p. 429, May, 1893.

1. For further information see the author's paper cited above.

and of the voltmeter as gathered from all experimental data was about .011 microfarad so that the real capacities at which resonance took place were .201 microfarad and 1.81 microfarads that is, in a ratio to each other as $1:3^2$. It will be seen, however, that a very accurate knowledge of capacity is not required in the following experiments:

The frequencies detected by the two-peaked curve, which I shall call the resonance diagram, were the fundamental and the first odd harmonic, that is, the harmonic of three times the frequency of the fundamental. The resonance diagram has, of course, as many peaks as there are frequencies in the inducing current.[1] The dotted curve (flat-peaked) in Fig. 2 was plotted on an enlarged scale from the readings taken in detecting the first harmonic, represented by the sharp peak of the resonance diagram, and represents this peak spread out, so as to show how the various readings fit into a well defined and symmetrical curve such as required

TABLE I.

| Capacity in M. F | Voltmeter readings in Volts. |
|---|---|
| .18 | 62 |
| .181 | 68 |
| .182 | 73.5 |
| .183 | 79 |
| .184 | 89 |
| .185 | 96 |
| .186 | 104 |
| .187 | 110 |
| .188 | 120 |
| .189 | 126 |
| .190 | 127 |
| .191 | 125 |
| .194 | 99 |
| .198 | 71 |
| .202 | Very low |
| 1.65 | 69 |
| 1.70 | 89 |
| 1.75 | 120 |
| 1.80 | 146 |
| 1.808 | 146 |
| 1.817 | 145 |
| 1.897 | 96 |
| 1.976 | 60 |

by theory. It also shows that a condenser of small subdivisions must be employed in order to detect higher harmonics. But it should be observed that these higher harmonics can also be detected with coarser subdivisions, provided the self-induction of the inertia coil is made small enough.

DESCRIPTION OF EXPERIMENTS.

The resonance diagram obtained by the method of Fig. 1 B gives the number of harmonics which are present in the inducing current. It does not give the exact value of the amplitudes of these harmonics. It would be somewhat premature to discuss the theory of the resonance diagram obtained by this arrangement, and to show how the ratio of the amplitudes of the harmonics to that of the fundamental frequency of the inducing current, that is the exact color of this current, could be calculated from the ratio of the height of the peaks in the resonance diagram. Suffice it, for the present, to mention only that the peaks of this diagram represent the amplitudes of the harmonics, magnified about proportionally to the square of the frequency. For instance, the resonance diagram in Fig. 2 tells us that the amplitude of the first odd harmonic in the inducing current is about one-ninth of the amplitude of the fundamental. The determination of the exact value of this ratio was not the object of the following experiments. Their aim was to detect the presence of harmonics, to trace their origin and to study their variation with the variation of the load, and of other elements of the circuit on which these harmonics seem to depend.

*Preliminary Tests.*—In order to form an estimate in how far the experimental data obtained by the arrangement of Fig. 1 B agreed with the theory, the following tests were applied:

*a. Study of the damping effect of the dielectric in the condenser.*

Let $L$=self-induction of the resonator circuit.

Let $R$=resistance of the resonator circuit.

Let $P$=amplitude of the difference of potential in the condenser when point of resonance has been reached.

Let $E$=amplitude of impressed electromotive force in the resonance circuit.

Then according to theory

$$P=\frac{p\,L}{R}E.$$

Hence if the $R$ is varied $P$ will vary also, but in such a way that

$$P\,R=\text{constant}.$$

That is to say, if we vary the resistance of a resonant circuit, and tabulate the voltmeter deflection for every particular resistance, and then plot a curve taking the resistances for abscissæ, and the voltmeter readings for ordinates we should, according to theory, obtain an equilateral hyperbola. Curves II and III, Fig. 3, were obtained that way, the frequency employed was that of the 10 horse power alternator, that is, 130 periods per second.

TABLE II.

| Resistance in Ohms. | Voltmeter Reading with a Mica Condenser | Voltmeter Reading with a Paraffin Condenser | Theoretical Value of Voltmeter Reading |
|---|---|---|---|
| 38 | 183 | 170 | 295.6 |
| 48 | 155 | 148 | 178.9 |
| 53 | 144 | 137 | 161.8 |
| 58 | 134 | 128 | 147.8 |
| 63 | 125 | 120 | 136 |
| 68 | 116 | 113 | 126 |
| 78 | 105 | 103 | 110 |
| 88 | 94 | 93 | 97.4 |
| 98 | 85 | 83 | 87.5 |
| 108 | 78 | 76 | 79.4 |
| 118 | 72.5 | 70 | 72.6 |
| 128 | 67 | 65 | 65.5 |
| 138 | 62 | 60 | 60 |

The experimental data from which they are plotted are given in Table II. Curve II was plotted from voltmeter readings obtained with a mica condenser. Curve III represents the corresponding readings obtained with a paraffin condenser and given in the third column of Table II. Curve I represents the theoretical curve, which would have been obtained if the law of variation of the voltmeter readings with the resistance had been the same throughout as it was at low readings. On account of the damping effect due to dielectric viscosity in the condenser a deviation from the above mentioned hyperbolic relation was, of course, expected, but it was quite a pleasant surprise to find a perfect regularity of these deviations. These curves indicate a rapid increase in the dielectric damping with the voltage, and also the superiority of mica to paraffin, especially at higher voltages. They also suggest that at low voltages and at frequencies over a hundred periods per second, this difference between the two substances is inappreciable. Similarly the damping effect of the magnetic viscosity of iron is small at low magnetizations, such, for instance, as would be produced by a telephonic current, and at frequencies which are well within the range of higher telephonic frequencies, say 750 periods per second. It is well to point out here that electrical resonance offers a very convenient method for studying the viscosity of iron and of dielectrics.

Similar curves and similar results were obtained with higher harmonics. This experimental test shows, therefore, that the relative values of the amplitudes of the harmonics to that of the fundamental frequencies are not seriously distorted by the dielectric damping of the condensers, especially when one operates with moderate voltages as was the case in the following experiments:

(*b*). *Second Test of the Resonator Indications.*—This test is represented graphically by diagram Fig. 4. Two transformers $C$ and $D$ had their secondaries connected in series. The primary of the air-core transformer $E$ formed a part of their circuit. The secondary of this transformer was a part of the resonator $F$. The transformer $C$, a Stanley 5 kilowatt (closed magnetic circuit) was fed by the 10 horse power alternator mentioned above (130 p. p. s.), the transformer $D$, of induction coil type with a cylindrical core of fine iron wire, was fed by a 1 horse power alternator with slotted armature (278 p. p. s.) Both alternators were run simultaneously at full excitation. First, the primary circuit of the large alternator was broken so that the current in the circuit $C\,D\,E$ was due to the action of the small machine alone. The resonator detected a resonant rise of 240 volts at capacity .407 microfarad, and another of 150 volts at capacity .044 microfarad. These were evidently the fundamental and the first odd harmonic. Then the circuit of the small machine was broken and that of the large machine closed, so that the current in the resonator was due to the action of the large machine alone. The resonator detected a resonant rise of 220 volts at capacity 1.78 microfarads. This corresponded to the fundamental frequency (130 p. p. s.) of the large machines. Finally both circuits were closed, so that the current in the resonator was due to the simultaneous action of the two machines. The same resonant rises of potential were detected by the resonator and at the same capacities as before, in perfect agreement with theory.

This experiment afforded another opportunity of testing the theory which underlies this resonance method of studying the wave curves of current and electromotive force. It is this: If two or more electromotive forces of different frequencies are impressed upon the resonator circuit and their resonant rises of potential are determined for a given resistance in this circuit, then, according to theory, the ratio of these rises should remain the same for all other resistances within the limits within which the periodicity of the circuit is practically independent of the ohmic resistance. Accordingly, the resistance of the resonator, $F$, Fig. 4, was varied gradually from 100 to 250 ohms, and the resonant rises of potential produced by the fundamental frequencies of the two machines (130 and 278 p. p. s.) were carefully determined for each particular resistance. The ratio of these rises remained constant to within five per cent., but the deviations were now in one direction and now in the other, and they were undoubtedly due to the variation in the excitation, and the speed of the small machine, both of which depended on the potential of the electric mains of the college plant, which of course, could not be kept very constant for so long an interval of time as is necessary for this experiment, which was about 15 minutes.

It is interesting to observe here that three air-core transformers like $E$, with three resonators like $F$, when placed in the circuit $C\,D\,E$, and each resonator tuned to one of the frequencies of the circuit represent an exact analogy of Helmholtz's well-known arrangement of acoustical resonators which he employed in the analysis of vowel sounds. The variety of exceedingly instructive experiments which one can perform with such a multiplex resonance circuit is very large and most interesting. It has long formed my favorite subject for an extended series of experiments whose results, however, are beyond the limits of this paper. In all experiments of this kind the voltmeter, which is attached to each resonator, performs the same office as König's sensitive manometric flames in the well-known experiments on acoustical resonance, and, it should be noted here, that they are just as sensitive. In fact, in electrical resonance experiments one is continually impressed with the striking resemblance between resonance phenomena in electricity on one hand and those in sound on the other. This resemblance is a trusty and suggestive guide.

FIG. 6. THE MEASUREMENT OF ELECTRIC CURRENT FOR DOMESTIC AND OTHER USES,—WEIGHING THE METER ZINCS.

(*c*.) *Sympathetic Resonance.*—Now, an acoustical resonator tuned to a certain pitch will respond feebly, to be sure, but distinctly, to a simple sound of a frequency which is an exact sub-multiple of its own frequency. A similar phenomenon might exist in electrical resonance, though ordinary alternating current theory does not lead us to expect anything of the kind. But some experimental results, which will be given below, led me to suspect that a sort of sympathetic resonance might exist, that is to say, a simple harmonic current might perhaps be capable of producing by induction a resonant rise of potential in a resonator, which is tuned to a frequency which is an exact multiple of the frequency of the inducing current. If that were the case, then a resonant rise of potential in a resonator would not necessarily mean that an upper harmonic in the inducing current has been detected, and, therefore, the indications of an electric resonator might be misleading. To investigate this point the air-core transformer $E$ with the resonator $F$, Fig. 4, was connected to the secondary of the 5 kilowatt transformer and the current gradually increased by varying gradually an electrolyte resistance. The feeding machine

[*Continued on page 31.*]

1. I have never detected an even harmonic in alternating current waves produced by ordinary commercial alternating current apparatus, and conclude, therefore, that such harmonics do not exist there. In machines of perfectly symmetrical construction even harmonics should of course not appear, as observed some time ago by Prof. Ayrton. Alternators with slotted armatures give waves in which all the odd harmonics up to the harmonic of nine times the frequency of the fundamental can be easily detected. As a rule the first odd harmonic is the strongest.

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THE proceedings of the convention of the Northwestern Electrical association at St. Paul this week will be watched with interest by many outside the immediate territory from which this organization secures its membership. As usual an attractive programme has been arranged, practical papers by experienced men have been secured, and there is everything to encourage the members to attend the meetings. The association is young and vigorous, it has adopted a conservative policy and is winning friends every year. It is receiving encouragement all along the line and it deserves success.

THE unfortunate events of the last few weeks in labor circles, although suspending to some degree the activity of electrical supply houses, were not accompanied by the more severe effects which for a time threatened the electrical industry in Chicago. The electrical workers, realizing that nothing was to be gained by a sympathetic movement in aid of the Pullman strikers and the American Railway Union, refused to leave their work. Had there been a strike among these men the injury to the electrical interests in the city would have been severe and the men are to be congratulated upon the wisdom they displayed in refusing to join a movement that could result in no gain to themselves, but which would temporarily cripple the industry which supports them. Considerable construction work is now being done in Chicago and the prospects for the future are encouraging, and it would have been most ill-advised had the action of the electrical workers been other than it was.

THE announcement made in another column of the incorporation of a syndicate which proposes to build an electric line to connect New York and Philadelphia, as well as to establish branch roads in New Jersey and the territory adjacent to the two cities, is a hopeful indication that this enterprise may yet attain realization, for the project of building such a system has been before the public for some time. The Pennsylvania Railroad company and the New Jersey Central Railroad company have been engaged in sharp competition for control of the traffic between New York and Philadelphia, and the incorporation of the new syndicate is regarded by many as a part of a plan of the Pennsylvania company to command the situation. Whatever the local aspect may be, the subject will certainly be of much interest to electric street railway men. Should the road be built it will offer new evidence of the growth of confidence in the trolley system, which heretofore has been recognized in this country more as a means of rapid transportation between points within a city than as a method of inter-communication between cities as widely separated as are New York and Philadelphia. In view of the opposition that has been made to the trolley ever since its introduction, a statement of the New York *Herald* in discussing the situation is of interest, illustrating as it does the general revision of opinion regarding the system which inevitably follows experience with it: "It is recognized on all sides as a very shrewd move on the part of the Pennsylvania management, in view of the inevitable necessity of the trolley, to steal a march upon its rival, thus accomplishing the double purpose of tapping its rival's exclusive strongholds and securing the monopoly of the small business along its own steam lines." It is pleasing to note that there is at last a metropolitan journal that realizes "the inevitable necessity of the trolley." The rights of way for the proposed road have been secured, and there is evidence of sufficient capital at hand to complete the construction.

MAYOR HOPKINS and the Chicago City Council are still engaged in the discussion of the trolley franchises that have occupied so much attention during the last year. The subject was brought up again at the last meeting by the mayor's veto of ordinances granting the South and North Side companies permission to substitute the trolley for horse cars. The mayor seems to have become weary repeating his views on the subject, for in his last veto message he contents himself "with merely recording his disapproval of this system of locomotion." There were others, however, who persisted in reiterating the old story about the "unsightly trolley" and the "danger" attending the operation of a line by this system, but all these arguments proved futile, for the council granted the franchises over the mayor's veto. By the terms of the ordinance as finally passed the South Side company will be permitted to introduce the trolley system throughout its Indiana avenue line whenever it shall have obtained consent of a majority of the property owners along the line. This is an important concession to the railway company, as it has heretofore been unable to get an ordinance for the Indiana avenue line north of Thirty-ninth street. It appears that when the company established the horse car line on this thoroughfare in 1886 an agreement was made with the property owners that no other method of propulsion be adopted. As a matter of fact this provision was insisted upon by the residents of the street to protect them from the invasion of the cable. But now this agreement is resurrected by those opposed to the trolley system. The ordinance, however, protects the property owners' interests, as it provides that a majority of them shall agree in writing to the change of motive power before the company can build the electric line. If it be shown that a majority of the property owners wants a trolley system, the old horse cars should be replaced with motor cars at once. It will certainly be a relief to the community when this matter is disposed of for all time.

THE present aspect of affairs in New York is that the new Rapid Transit Commission will adopt a plan for an underground electric road, and recommend to the constitutional convention now in session at Albany that it be constructed at public expense, and that a vote of the people should be taken upon the subject next fall. It is regarded as most likely that Boston will partially solve its problem of rapid transit in a similar manner, a bill being before the Massachusetts legislature at the present time authorizing the improvement. Electricity is closely connected with both of these schemes on account of its superiority over other power for such an application. At the same time more activity than ever before is being displayed in its adoption by elevated railroad companies. One road in Chicago has its electrical machinery in process of construction, while others in the same city have practically chosen it, and the Manhattan company in New York has again taken the subject under advisement. Both overhead and underground, the desirability of electricity as a means of propulsion is generally recognized and is meeting with gratifying encouragement.

In view of the interest felt in New York and Boston in underground electric roads, it is interesting to observe the activity displayed in this matter in London. There parliamentary powers have been obtained for a number of underground electric roads in the metropolitan area of the city. The six most important are the City & South London extension to Islington, Central London, Shepherd's Bush to Liverpool street, Waterloo & City, Great Northern & City, Finsbury Park to Moorgate street and Hampstead & Charing Cross. These proposed roads are all designed on the Greathead system, and will be at a depth below the surface varying from 40 to 70 feet. The Waterloo & City road is in an active state of construction.

In this country both New York and Boston stand in need of underground electrically operated roads, and decisive action by one city would doubtless be followed by the other.

IT has been generally believed that all the elevated railways in Chicago would eventually become electric roads, but it was not expected that the change would be made on the existing roads for some time, although it was known that the companies were looking into the relative cost of operation. Now it appears that the management of the Lake street road has determined upon its policy in regard to changing the motive power, and on other important points. A financial writer in the Chicago *Herald* is responsible for the following bit of interesting gossip: "The directors of the Lake street elevated road have made substantial progress in the consideration of matters which will result in bringing the Lake street and Northwestern elevated companies in close relations. In consequence of the purchase of a controlling interest in the Lake street company by people identified with the Northwestern elevated, it is stated positively that the schemes of the Lake Street company to build a line on the North side, and of the Northwestern elevated to tunnel through the business district have both been abandoned. The Northwestern elevated, although it has built no road as yet, is the real power behind the throne. The men who have bought the control of the Lake street elevated are prepared to make that road subservient to, or at all events keep it in harmony with, the Northwestern elevated, and also to change the competition with the surface roads to a friendly character. It is already practically decided on that the Northwestern and the Lake street roads will have one management, and that both roads will be operated from the same electric power station as soon as one can be built. The change to electric power will effect an important saving for the Lake street company. It is stated positively, furthermore, that the Northwestern road will be built as originally intended, but that it will use the terminal of the Lake street road south of the river." With the Northwestern and Lake street roads following the example of the Metropolitan, and the Alley "L" management seriously considering a similar movement, the outlook in this particular branch in Chicago at least is very promising.

THE paper on "Resonance Analysis of Alternating and Polyphase Currents," presented elsewhere in this issue, was prepared for the American Institute of Electrical Engineers by Dr. Pupin, and was presented at the last general meeting. It was a matter of general regret that this paper was not read earlier in the meeting, so as to give the members an opportunity to discuss the results obtained in the experiments. The investigation has been far-reaching and thorough, and the conclusions arrived at after a careful study of the phenomena will no doubt be of material assistance to future investigators in this line. But Dr. Pupin does not believe that the proper time has arrived for the formulation of a physical theory which will give a complete account of the peculiar behavior of iron, by means of which it superposes odd harmonics upon the wave of a simple harmonic current. His view, however, is that upper harmonics will be generated whenever more or less abrupt changes of the magnetic state occur in any part of the magnetic field through which an alternating current flows. These abrupt changes may be introduced by a slotted core armature or an armature made up of coils with iron cores distributed over a drum common to all of them. An alternating current motor, especially when it is not of a smooth core armature type, will also cause abrupt changes of magnetism and strong deviations of the feeding current from the simple harmonic form. This leads to the conclusion that every complete cycle of magnetization to which iron is subjected, when under the inductive action of a simple harmonic current, must be accompanied by some abrupt changes in magnetism, whether the mean magnetic intensity of the cycle be large or small. These abrupt changes may be accounted for in many ways, and here a wide field of speculation is afforded, but Dr. Pupin has satisfied himself by his study that hysteresis, as commonly understood, will not account for them; for, as he points out, these peculiar abrupt cyclic changes, if they really exist and are the cause of harmonics, are not affected by mechanical vibrations by which, as is well known, all hysteretic effects are influenced very much. He concludes that, whatever the real theory underlying these upper harmonics may be, the bare fact which the engineers have to face is that there is no cure against harmonics as long as the circuits contain iron. His advice is, therefore, to construct lines in such a way that conditions favoring resonance with the frequency of the fundamental or with one of its odd upper harmonics will seldom occur, and whenever they do occur the resonant rise of potential should not be capable of producing any damage. He adds a warning to avoid slotted armatures and armatures with projecting pole pieces, and to keep the magnetization down as much as possible.

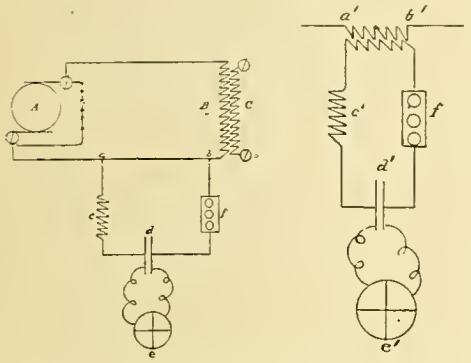
## Resonance Analysis of Alternating and Polyphase Currents.

[*Continued from page 29.*]

was the 10 horse power alternator already mentioned with smooth core armature. Here I must disturb somewhat the logical sequence of this paper by stating that the secondary current, produced by this machine and transformer, when flowing through a non-self-inductive resistance in the external circuit or through a coil of small self-inductance possessing no iron core showed under ordinary tests no distortion worth mentioning. But when the secondary current was increased, and with it the electromotive force induced in the resonator, the harmonics began to appear more and more distinctly. When the secondary current was 11.5 amperes and the electromotive force induced in the resonator was 133 volts the resonant rise of potential was as follows:

For the harmonic of:
- 3 times the frequency of the fundamental the potential rose from 133 to 155 volts.
- 5 times the frequency of the fundamental the potential rose from 133 to 139 volts
- 7 times the frequency of the funamental the potential rose faintly.
- 9 times the frequency of the fundamental the potential rose not perceptibly.

The resonant rise with the fundamental frequency would




FIGS. 1A AND 1B. RESONANCE ANALYSIS OF ALTERNATING AND POLYPHASE CURRENTS.

have been with the initial potential of 133 volts several thousand volts, so that the resonant rises obtained for the upper harmonics were extremely small in comparison. The conclusion is, therefore, that if such a thing as sympathetic resonance really exists it is so feeble at small initial voltages in the resonator as to escape detection. It could, therefore, in no way modify the results recorded in this paper, since these were obtained almost invariably with resonant rises of potential which started from very small initial voltage.

These preliminary experimental tests demonstrate clearly that a resonator of the type given in Fig. 1B is quite capable of detecting all the frequencies that may exist in an alternating current wave, that its indications are in good agreement with the theory as far as the fundamental frequency is concerned and that it gives us a fairly approximate idea of the relative strength of the harmonics. Additional evidences proving the correctness of its indications will be found among the results of the following experiments:

### IV.—Location of the Origin of Upper Harmonics.

#### A. Experiments with Alternator of Smooth Core Armature.

*1st Series.*—The first set of experiments in this direction was performed with the 10 horse power Fort Wayne 8 pole alternator with smooth core armature and the Stanley 5 kilowatt transformer (closed magnetic circuit). The secondary circuit was open and a Cardew voltmeter indicated the secondary voltage. The current which excited the field of the alternator was gradually increased. The secondary voltage measured the strength of this excitation. The air-core transformer with the resonator was inserted into the primary circuit as indicated in Fig. 1B. The

TABLE III.

| Secondary Voltage. | Resonant Rise in Volts Due to the Fundamental. | Resonant Rise in Volts Due to the First Odd Harmonic. |
|---|---|---|
| 43 | 132 | 58 |
| 48 | 130 | 65 |
| 53.5 | 136 | 72 |
| 58 | 138 | 73 |
| 62 | 146 | 80.5 |
| 66.75 | 152 | 86 |
| 75 | 160 | 94 |
| 83 | 170 | 104 |
| 88 | 175 | 110 |
| 97 | 185 | 117 |
| 104 | 195 | 128.5 |

resonant rise of potential recorded by the multicellular voltmeter $e'$ was carefully determined at every excitation for the fundamental frequency and the first odd harmonic. Higher harmonics were present, but very faint. The results are given in Table III and plotted in Fig. 5. The initial voltage in the resonant circuit was small, just perceptible in the multicellular voltmeter.

The curves in Fig. 5 were plotted from this table by taking the readings of the first column for the abscissæ and the corresponding readings of the second and third columns for ordinates. The upper curve corresponds to the fundamental and the lower curve to the harmonic. The two curves are too straight lines parallel to each other, which means that the fundamental and the harmonic increase at the same rate from nearly one-third excitation to full excitation of the alternator. This result I did not expect, but its correctness was verified beyond all reasonable doubt.

The same series of experiments was extended to lower excitations of the alternator, but, since I had no low reading alternating current voltmeter, the excitation was measured by measuring the exciting field current. This current was 10 amperes at full excitation and the series of experiments extended down to 1.5 amperes, hence to nearly one-seventh of the full excitation. To bring the readings of the resonant rises of potential within the scale of the multicellular voltmeter at low excitations the number of turns in the air-core transformer was suitably increased. Within all these limits of excitation both the fundamental and the harmonic increased at the same rate and proportionally to the excitation. This curious relation I mistrusted at first and suspected the existence of something like sympathetic resonance mentioned above. But all experimental evidence is in favor of its correctness.

*2d Series.*—To determine whether the presence of the harmonic was due to the action of the transformer or to that of the alternator, the transformer was disconnected, and two series of incandescent lamps, connected in parallel, were substituted in its place. Each series consisted of 13 lamps, each about 24 candle power. The resonator, with its air-core transformer, remained in circuit as before. First one series of lamps was placed in circuit. The rise due to the fundamental was stronger than in the preceding experiments, but that due to the harmonic was exceedingly faint. When both series of lamps were thrown in the harmonic appeared a trifle stronger, but still very weak. Hence the inference that the harmonic was due almost exclusively to the action of the transformer.

It should be observed here that the alternator armature, though well laminated, runs fairly hot in a short time, hence it must be the seat of a decidedly strong hysteretic process. On the other hand, the transformer does not heat nearly as much as the alternator armature, and yet its action produces the harmonic. This certainly seems to speak strongly against the view that harmonics are due to hysteresis. Other evidences against this view will be given below.

*3d Series.*—A series of experiments with open magnetic circuit transformers of induction coil type in place of the lamps showed the harmonic much stronger than the lamps did, but weaker than the experiments with the transformer of closed magnetic circuit. Although I have not succeeded in obtaining accurate numerical comparisons between the two types of transformers in this respect, one thing is certain, and that is, closed magnetic circuit transformers distort under similar conditions the primary current considerably more than transformers with open magnetic circuits; on the other hand, in the first case the distortion is confined almost entirely to the primary circuit, when the secondary is closed by a non-self-inductive resistance, whereas in the second case it is felt in the secondary circuit also, though considerably less than in the primary.

The general conclusion of this group of experiments may be summed up as follows:

I. A ferric self-inductance in circuit with an alternator which gives a simple harmonic electromotive force distorts

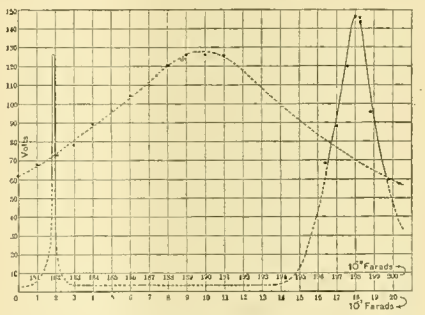



FIG. 2. RESONANCE ANALYSIS OF ALTERNATING AND POLYPHASE CURRENTS.

the current by introducing higher odd harmonics, principally the harmonic of three times the frequency of the fundamental.

II. This harmonic (and in all probability all other harmonics) increases at the same rate as the fundamental when the excitation increases, the rate of increase being up to 4000 C. G. S. lines of force per sq. cm. proportional to the intensity of magnetic induction in the core of the ferric inductance.

III. When this ferric induction is a transformer then the distortion appears, but not seriously, in the induced secondary electromotive force, if the transformer has an open magnetic circuit, it does not appear there to any extent worth considering if the magnetic circuit is a closed one.

IV. A practically simple harmonic electromotive force is produced by alternators with smooth core armatures, even if the machine is worked at considerable degrees of magnetization of the armature core.

#### B. Experiments with Alternator of Slotted Core Armature Type.

The machine employed in these experiments was the 1 horse power alternator mentioned. It is a 16-pole machine; its armature is a Crocker-Wheeler 1 horse power motor armature wound for 500 volts. It gives at full excitation, and the speed at which I usually ran it in these experiments was about 1,500 volts.[1] The transformer connected with it was of induction coil type with a cylindrical iron core made up of very carefully insulated thin iron wire. The same series of experiments were performed as under group A. The first series in this group gave exactly the same results as the corresponding series in group A. The excitation varied from one-seventh of the full to the full excitation; the amplitude of the fundamental and the first odd harmonic[2] varied at the same rate during the whole interval, so that a parallel pair of straight lines like those in Fig. 5 could be plotted in this case also. The second series resulted in the conclusion that the harmonic was very strong and due in a very large measure to the action of the armature and not to that of the transformer as in the other case, although the transformer also contributed a distinct but small measure to the strength of the harmonic. The third series showed that the harmonic appears in the secondary of an open magnetic circuit transformer, although considerably weaker, but does not appear there to any appreciable extent when the magnetic circuit is a closed one.

To the four conclusions given at the end of the series of experiments under group A we may, therefore, add the following additional conclusions:

V. An alternator with slotted core armature produces a complex harmonic electromotive force in which the upper harmonic of three times the frequency of the fundamental is generally by far the strongest.

VI. The amplitudes of the fundamental and the harmonic increase at the same rate with the increase of excitation; this rate is proportional to the excitation, that is to say, proportional to the magnetization of the armature.

VII. A ferric inductance in circuit with a slotted iron core armature introduces no new harmonics. It seems to strengthen those already existing in the electromotive force, that is odd harmonics, especially the first odd harmonic.

The same conclusions will evidently hold true for alternators of ordinary types, that is, alternators whose armature is made up of coils wound on iron cores which are bolted to a cylindrical iron drum common to all of them.

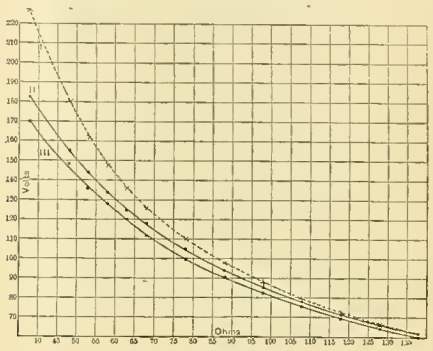



FIG. 3. RESONANCE ANALYSIS OF ALTERNATING AND POLYPHASE CURRENTS.

#### V. Effect of the Load upon the Harmonics.

It is a well known fact that the distortion of the primary current disappears gradually with the increase of the secondary load, that is, when the external part of the secondary circuit is a non-self-inductive resistance. The question arises now, what becomes of the harmonics which produce the distortion in the primary when the secondary current increases? The following experiments seem to answer this question definitely.

The arrangement of circuits was that given in Fig. 1B. The secondary circuit of the large 5 kilowatt transformer contained an electrolyte resistance and the secondary current was measured by means of a Siemens electro-dynamometer. For every particular value of the secondary current the resonant rises of potential due to the harmonic and the fundamental were carefully determined by means of the multicellular voltmeter. Table IV contains the observations relating to the harmonic of three times the frequency of the fundamental; Table V relates to the fundamental (130 p. p. s.) The apparatus employed were the large alternator and the 5 kilowatt transformer.

Table V requires explanation. When the secondary current was over 3.6 amperes the resonant rise of the fundamental was too high for the voltmeter employed and also too risky for the condenser. An auxiliary resistance had to be introduced into the resonator to bring the resonant

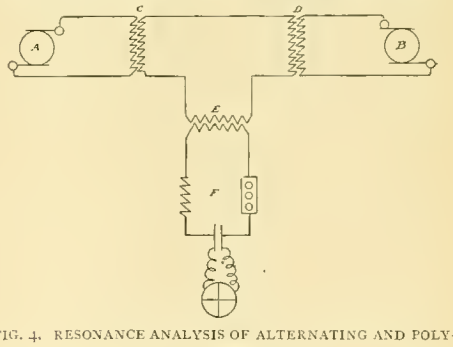



FIG. 4. RESONANCE ANALYSIS OF ALTERNATING AND POLYPHASE CURRENTS.

rise down to the limits of the voltmeter. These auxiliary resistances are given in the third column. The readings that would have been obtained without these auxiliary resistances were then calculated, roughly, as follows: According to theory, which was verified by experiments described in the beginning of this paper, the resonant rise multiplied by the resistance of the resonator gives a constant product for all resistances as long as the period of the resonator is practiaally independent of these resistances. The resistance of the resonator coils was 16 ohms. Hence, if, for instance, $x$ denote the rise which would have been obtained without auxiliary resistance in the resonator when the secondary current was 5 amperes, then since with an auxiliary resistance of 50 ohms the resonant rise was 122 volts we have with a rough approximation

$$x = \frac{122 \times 66}{16} = 503 \text{ volts.}$$

In this manner the figures of the fourth column were ob-

1. A more complete description of this machine and the transformer will be found in *American Journal of Science*, June, 1893, p. 510, etc. Owing to the accident which somewhat impaired the insulation of the armature the machine was run last year at low excitation, and hence low voltage, although the speed was then considerably higher.

2. The second odd harmonic, that is, the harmonic whose frequency is five times that of the fundamental, was there but weak.

tained. They are only very rough approximations, but still they give a very fair idea of the ratio of the fundamental to the upper harmonic at various loads. Curves I and II, Fig. 6, were plotted from these data. The secondary amperes were taken for the abscissæ and the corresponding resonant rises in volts for the ordinates. Curve III represents Curve II plotted on a different scale for the volts of the resonant rise of potential. These are given in the right hand vertical column of the diagram. This curve gives a better picture of the gradual apparent increase of the harmonic. An inspection of I and II shows clearly how much more rapidly the fundamental increases than the harmonic. In reality the increase is even more rapid; for according to Table V it appears as if the strength of the harmonic increased with the secondary current, only much less rapidly than the fundamental. For instance, at open secondary the voltmeter indicated 65 volts for the resonant rise of the

TABLE IV.

| Secondary Current in Amperes. | Resonant Rise of the Harmonic in Volts. |
|---|---|
| 0 | 65 |
| 3.6 | 65 |
| 4.8 | 66 |
| 6.9 | 68 |
| 8.5 | 70 |
| 11.5 | 76 |
| 15.7 | 85 |
| 20 | 97 |
| 28 | 120 |
| 40 | 162.5 |
| 56 | 202 |

fundamental; and at 56 amperes in the secondary this rise was indicated by 202 volts. But it must be noted that in the first case the voltmeter needle went from practically zero at no resonance to 62 when resonance was reached; whereas in the second case it went from 135 volts at no resonance to 202 volts when resonance was reached, so that the real resonant rise was practically the same in both cases. Similarly for all other loads in the secondary. It follows, therefore, that if the harmonic increased at all with the increase of the load this increase was much smaller than appears at first sight from the data of Table V. The more important conclusion, however, which follows from this experiment and which I wish to point out more particularly is that the harmonic which manifests itself in the distortion of the primary current when there is no load in the secondary is present at all loads, if not stronger, then certainly with about the same strength. At full load this harmonic could not possibly be detected by Joubert's method of sliding contact; it is so exceedingly small in comparison to the fundamental.

This persistence of harmonics at all loads, even when completely hidden by the fundamental wave, holds true also when their origin can be traced to the action of the armature of the generator as in the case of the machine with slotted iron core armature. In all cases their strength seems to depend upon the mean intensity of magnetization of the magnetic circuits to which they owe their origin and upon nothing else.

Another somewhat more difficult but very instructive way of proving the persistence of the harmonics is represented in Fig. 7. In circuit with the primary of the large machine and transformer described above are two equal air-core transformers, *a b* and *a' b'*. By means of a double switch either one of the two can be made a part of the resonating circuit *c d f*. A number of condensers *D* in series, are connected across primary circuit as indicated. The two air-core transformers *a b* and *a' b'* will be equivalent when the resonator voltmeter, *e*, gives the same indications, no matter which one of the two transformers be connected to the resonator. This balanced arrangement having been obtained, the balance will be disturbed as soon as the condenser *D* is plugged in, and it will be disturbed in a great variety of ways, according to the capacity plugged in. But when the transformer *B* is of closed magnetic circuit type, then the resonator indications remain practically the same as long as the resonator is switched on the air-core transformer *a b* no matter what capacity is plugged in the condenser *D*. When the resonator is switched on the air-core transformer *a' b'* then its indications will be different for every particular capacity in *D*. In fact the circuit *A a b*

TABLE V.

| Secondary Current in Amperes. | Resonant Rise of the Fundamental in Volts (observed) | Auxiliary Resistance in the Resonator in Ohms | Resonant Rise of the Fundamental in Volts (calculated) |
|---|---|---|---|
| 0 | 80 | 0 | 80 |
| 3.6 | 240 | 0 | 240 |
| 5.0 | 150 | 50 | 503 |
| 6.7 | 150 | 50 | 646 |
| 9.0 | 200 | 50 | 875 |
| 17.3 | 200 | 100 | 1,450 |
| 32.0 | 185 | 210 | 2,613 |
| 44.0 | 155 | 410 | 4,197 |
| 56.0 | 160 | 510 | 5,400 |

*D, A*, can be treated as an entirely separate circuit from the circuit *A a' b' B A*.

This statement needs practically no modification in order to cover that case also in which the self-inductance of the primary of *B* is diminished by putting a non-self-inductive load on the secondary. This utter disagreement between theory and experiment deserves a closer discussion, but since its connection with the subject of this paper is only an indirect one I prefer to reserve it for some other time. That which has a direct bearing upon the present discussion is the method which the above mentioned relation offers for observing the variation of the harmonics with the load without the disturbing inductive effect of the large primary current. It is this: Connect the air-core transformer *a b* (and with it the resonator), in series with the condenser. Add to this series an auxiliary coil *c* (no iron core). By the combination thus obtained, bridge the primary circuit, so that in place of the simple condenser bridge *D* given in Fig. 7, there will be a bridge consisting of condenser *D*, the air-core transformer *a b* and the auxiliary coil *c*. The office of the auxiliary coil will be explained presently. The secondary *C* being open, tune the circuit consisting of the alternator armature, the primary conductors up to the bridge, and the bridge to any one of the harmonics. The tuning is done by means of varying the capacity of the condenser and the self-inductance of the auxiliary coil. Then close the secondary circuit by means of an electrolyte resistance and vary the secondary current. It will be found that the harmonic diminishes only slightly with the increase of the secondary load. As an example I give the following: The circuit just mentioned was tuned to the harmonic of five times the frequency of the fundamental, that is 650 p. p. s. At no load the resonator indicated a rise of 108 volts, at full load the rise was 94 volts. But this drop, small as it was, might have been caused by armature reaction.

Whatever the ultimate meaning of the appearance and the persistence of the odd harmonics in an alternating current wave may be I am not quite prepared to state with any high degree of confidence. One thing is certain, and that is that they are present at all loads with almost undiminished strength. Their presence is hidden by the fundamental wave at heavy loads, but when conditions favoring resonance with any one of them arise they will certainly come out and do all the mischief they can to the insulation. The self-induction of a motor or that of a closed magnetic circuit transformer has practically no bearing upon the conditions of their resonance. These conditions depend in such circuits solely upon the self-induction of the alternator on the one hand and the self-induction and static capacity of the line on the other. According to the experiments just described the resonant current is confined entirely to the alternator and the line, the dielectric forming a part of its circuit. These observations will be modified in the case of transformers with open magnetic circuits and their equivalents, that is, closed magnetic circuits possessing considerable magnetic leakage, especially when the conditions of the line favor resonance with the fundamental frequency, this frequency being low; such magnetic circuits possess much less magnetic sluggishness and can influence considerably the conditions of resonance with a low frequency.

### VI. DISTORTION OF THE SECONDARY CURRENT.

It was pointed out that the superposition of harmonics upon the fundamental wave was confined to the primary circuit when the secondary is closed by a non-self-inductive resistance,

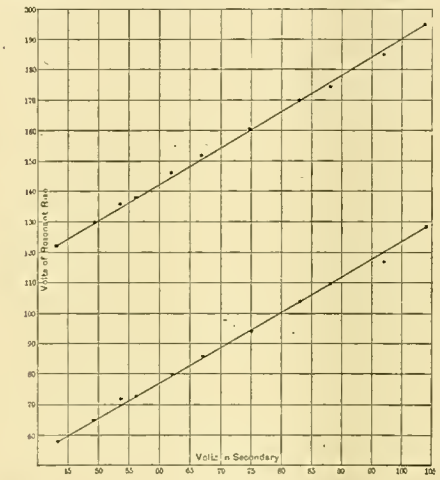



FIG. 5. RESONANCE ANALYSIS OF ALTERNATING AND POLYPHASE CURRENTS.

that is, if the transformer is of closed magnetic circuit type. With an open magnetic circuit transformer the deviation of the primary current wave from the simple harmonic form, due to action of the generator or the transformer or both, is felt more or less in the secondary current also. If, however, the secondary is closed by a ferric self-inductance then odd harmonics will appear in this circuit also in both types of transformers. In fact, the secondary circuit should now, as far as the harmonics are concerned, be considered as a separate circuit, in which the secondary coil of the transformer and the ferric inductance in the secondary circuit play in the same part as the armature of the alternator and the transformer play in the primary circuit.

The series of experiments which related to the origin and growth of harmonics in the secondary circuit was exactly the same as the one described above, by means of which the so-called distortion of the primary current was studied. The results were the same. The presence of harmonics is due to the action of the ferric inductance; their strength increases proportionally to the intensity of magnetization of the iron in the ferric inductance. They seem to be entirely independent of hysteresis, that is, if by hysteresis the process be understood by means of which most of the heat is generated in a very finely laminated, well insulated and well annealed iron core, when such a core is subjected to rapid reversals of magnetism. I shall describe briefly an experiment bearing upon this point. The secondary circuit of the five kilowatt transformer was closed by an electrolyte resistance, and a short cylindrical coil having about 120 turns coarse copper wire. A short cylindrical core made up of very fine (No. 26 B. and S.) and well annealed iron wire could be inserted into this coil. The core was 40 centimeters high and 5 centimeters in diameter. The wires were fairly well insulated from each other. A layer of fine copper wire surrounding this coil formed part of the resonator circuit. First, the secondary current was passed through the coil before the iron core was inserted. The resonator could detect no harmonic worth mentioning even when the current was increased almost to full load. But as soon as the iron core was introduced the odd harmonics appeared, especially the third harmonic; its strength increased proportionally to the current. Placing now another similar iron core on the top of the first and adjusting it in such a way that it allowed a small rocking motion, the two cores could be set into a violent vibration by the inductive action of the current which gave a very loud note, corresponding in pitch to the frequency of the alternator. The vibration could be stopped by pressing the top core against the lower core and against the table. The vibration produced no appreciable difference in the strength of the harmonic; if anything it seemed to make it stronger. This experiment seems to me to render the theory, which ascribes the origin

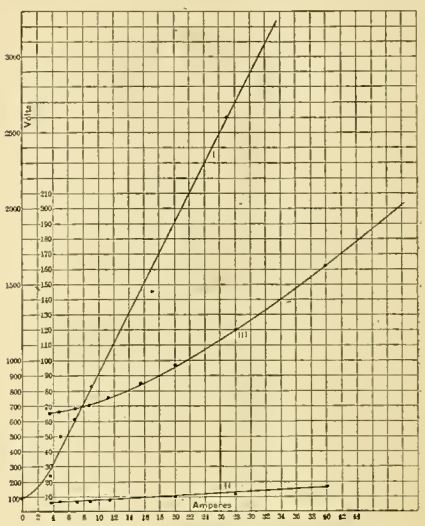



FIG. 6. RESONANCE ANALYSIS OF ALTERNATING AND POLYPHASE CURRENTS.

of harmonics to the hysteretic action of iron, completely untenable.

I do not think that the proper time has arrived yet for the formulation of a physical theory which will give a complete account of the peculiar behavior of iron, by means of which it superposes odd harmonics upon the wave of a simple harmonic current. The view which irresistibly suggests itself to my mind is simply this: Upper harmonics will be generated whenever more or less abrupt changes of the magnetic state in any part of the magnetic field through which an alternating current flows occur. A slotted core armature or an armature made up of coils with iron cores distributed over a drum common to all of them will introduce such abrupt changes. An alternating current motor, especially when it is not of a smooth core armature type, will also cause abrupt changes of magnetism and hence cause strong deviations of the feeding current from the simple harmonic form. But if this view be correct, then every complete cycle of magnetization to which iron is subjected when under the inductive action of a simple harmonic current must be accompanied by some abrupt changes in magnetism, and that, too, whether the mean magnetic intensity of the cycle be large or small. A great many things may be suggested which could account for such cyclic abrupt changes. One thing is certain and that is, that hysteresis, as commonly understood, will not account for them; for these peculiar abrupt cyclic changes, if they really exist and are the cause of harmonics, are not affected by mechanical vibrations by which, as is well known, all hysteretic effects are influenced very much. But whatever the real theory underlying these upper harmonics may be, the bare fact which the engineers have to face is:

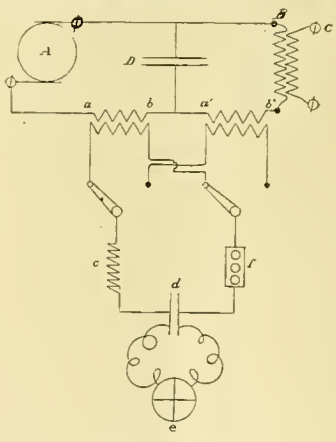



FIG. 7. RESONANCE ANALYSIS OF ALTERNATING AND POLYPHASE CURRENTS.

There is no cure against harmonics as long as the circuits contain iron. Hence construct your lines in such a way that conditions favoring resonance with the frequency of the fundamental or with one of its odd upper harmonics will seldom occur, and whenever they do occur the resonant rise of potential should not be capable of producing any damage. Avoid slotted armatures and armatures with projecting pole pieces and keep the magnetization down as much as possible.

### VII. FLUCTUATIONS OF THE ROTARY FIELD.

Before closing this paper I will describe briefly the application of the resonance method of analysis to the study of the intensity fluctuations of a rotary magnetic field. The investigation was carried out by two students of the electrical deparment of Columbia College at my suggestion, and will be published in the near future. The method,

briefly stated, is this: A suitable number of turns of wire are subjected to the induction of a rotary magnetic field. These turns form part of a resonator. Whatever fluctuations there be in intensity of the rotary field they will be periodic, their period bearing a perfectly definite ratio to the periodicity of the current which produces the rotary field. For instance, in a three-phase combination of alternating currents, the intensity of the rotary field will, according to theory, show six maxima and six minima during each complete revolution, the maxima differing from the minima by about 14 per cent. A circuit, subjected to the inductive action of such a field should have a periodic electromotive force induced in it whose frequency will be either three or six times the frequency of the fundamental, according to the shape of the curve of fluctuations; similarly in a rotary magnetic field produced by a two-phase combination

PORTABLE ALTERNATING CURRENT METER.

of alternating currents. If such electromotive forces were induced the resonator would detect them, and from the resonant rise of potential the extent of the fluctuations producing these electromotive forces could be estimated.

No electromotive forces of this type were detected in either a triphase or a two-phase combination. Hence the inference: Rotary magnetic fields produced by reasonably well constructed machines are not accompanied by fluctuations in their intensity.

In conclusion I wish to thank my friend, Prof. H. A. Storrs of the University of Vermont, who during his whole stay at my laboratory this year was always anxious to aid me in my work in a most ready and disinterested way. His most efficient assistance was of the greatest value to me.

## Portable Alternating Current Meter.

The portable instrument, shown in the illustration, by means of which accurate measurements may be made of alternating currents, is now being placed upon the market by the General Electric company. It is small and handy and combines strength, permanency and reliability with compactness of form and excellence of workmanship. The scale is unusually long and reads to fine divisions. The instrument, although designed for alternating current

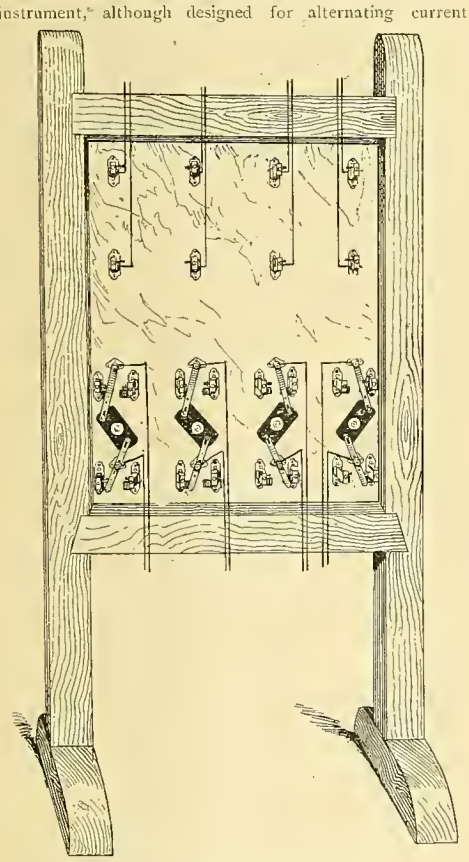


FIG. 2. THE SAWYER SWITCHBOARD.

measurements, may also be used for measuring direct currents, but for this work it requiries special calibration. It is made in 25, 50, 100 and 200 ampere sizes.

It is reported from Portland, Ore., that the Vancouver & Northern Railway company has been formed with a capital stock of $3,000,000, to construct railroads, telegraphs and telephone lines,

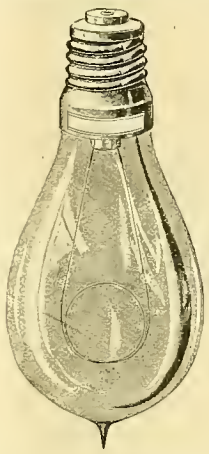
## High Economy Incandescent Lamps.

After a series of exhaustive experiments covering several months, under the supervision of J. E. Randall, the Columbia Incandescent Lamp company announces that it is prepared to furnish to its customers a superior lamp of high efficiency in voltages of 100, 110, etc.

The filament of this lamp, which is shown in the accompanying illustration, is made by an entirely new process which enables the production of very uniform results, and also the manufacture of lamps having a much higher economy than lamps of the same voltage heretofore placed on the market. A comparative test of these lamps shows that they will maintain their candle power to a higher degree at a higher efficiency than is common. While the filament is made in coiled form on account of its extreme length, the special feature of the lamp is that the material from which the filament is made is superior, making it more homogeneous and uniform in results. The use of this lamp, the company claims, will show a saving to the consumer in energy of from 15 to 20 per cent., and thereby a corresponding additional output to the station.

## New Reversing and Speed Controlling Device for Electric Launches.

The commissioners of Lincoln Park, Chicago, have added to the many attractions of that beautiful park, four electric launches purchased from the Electric Launch & Navigation company, which operated them at the World's Fair. The commissioners awarded to the Cutler-Hammer Manufacturing company, Chicago, the contract for designing and manufacturing the combined reversing device and



HIGH ECONOMY INCANDESCENT LAMPS.

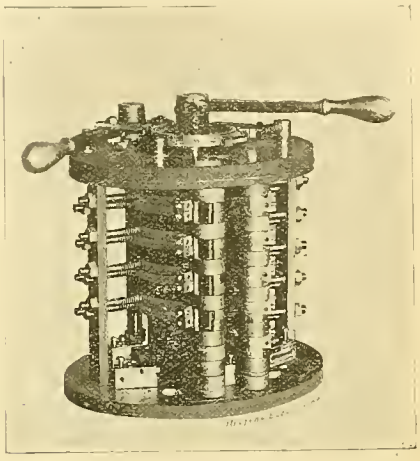
speed controller, suitable for their use, shown in the accompanying illustration. The device is compact and consists of an upright cylinder eight inches long with properly arranged segments to give the desired speeds, three in number. These segments are connected with the batteries by means of five sets of brushes, held to their places by readily adjustable springs. The brushes are so arranged that they can be removed with the greatest possible ease and all parts are very heavy and substantial to stand the hard usage generally received by this sort of apparatus.

The cylinder is operated by a brass lever to which is attached a cam that engages with a stop in such a manner as to indicate both to sight and feeling when the cylinder has rotated to the proper position for each speed. The reversing device is operated by a similar lever and the arrangement is such that it is impossible to reverse the motor without first revolving the cylinder back to "full off," but the reversing handle may be used to open the main circuit instantly, with the controller in any position. This controller is the result of careful throught and the manufacturer was fully alive to the possible dangers to both passengers and motor through careless or ignorant handling, and has reduced the possibility of accident from these causes to a minimum.

## Canadian Electrical Association.

The next convention of the Canadian Electrical association will be held in Montreal, Que., during the latter part of September. The convention will be held in the Mechanics' Institute building, and will extend over three days' —one business session being held on the first day, two on the second day, and one on the forenoon of the third day. The papers that will be brought before the convention include "The Possibility of Securing Better Regulation at Central Light and Power Stations by means of Accumulators of Improved Construction," by John Galt, C. E. and M. E., Toronto; "A Method of Distribution with Equalization of Potential Difference," by D. H. Keeley, of the Government Telegraph Service, Ottawa; "The Application of Electricity for Medical and Kindred Purposes, from Light and Power Circuits," by W. B. Shaw, Montreal; "Electrolysis," by J. A. Baylis, Bell Telephone company, Toronto; "Telephone Cables, their Construction and Maintenance," by F. J. F. Schwartz, Bell Telephone company, Montreal, and "Alternating Motors," by L. M. Pinolet, Montreal. Papers will also be read by John Langhton, Toronto, E. C. Breithaupt, Berlin, Ont., and T. R. Roseburgh, Toronto.

The social part of the programme will include visits to



NEW REVERSING AND SPEED CONTROLLING DEVICE FOR ELECTRIC LAUNCHES.

McGill University, the power station of the Montreal Street Railway company and other electrical works; an excursion to Lachine and down the Rapids; trip over the Montreal Island railway, an inspection of the docks and ocean steamers, C. H. Mortimer, Toronto, is secretary of the association.

## The Sawyer Switchboard.

The accompanying cuts illustrate a new switchboard which is manufactured and is being put on the market by the Turner Brass Works, Chicago. This board was designed by R. F. Sawyer, electrician of the Chicago Arc Light & Power company. Mr. Sawyer for a number of years has had charge of the large switchboard in the Market street station of the company, and the board shown is the result of

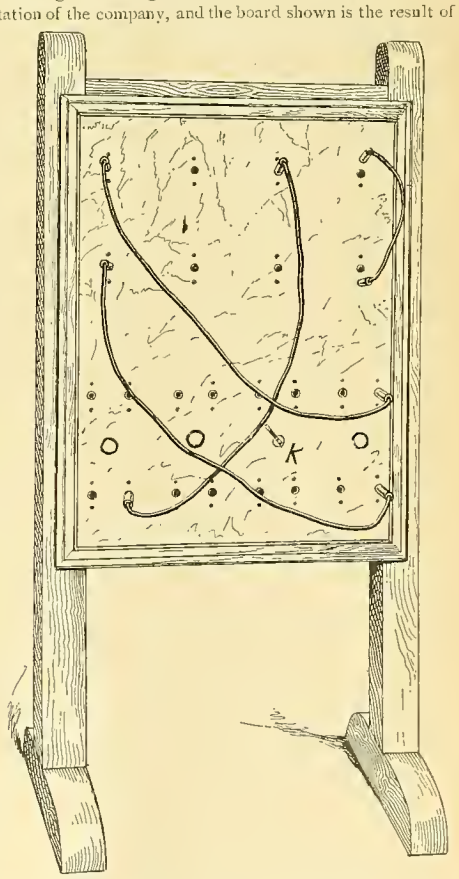


FIG. 1. THE SAWYER SWITCHBOARD.

his study of the requirements necessary for handling quickly and easily a large number of high tension circuits. It should also be noted to the credit of Mr. Sawyer that this design of board was in service in the Market street station for one year before the fire, which took place two years ago. After the fire a new board was built according to the same design as the

old Sawyer board and this fact alone is the strongest recommendation that could be required.

In order to appreciate the chief features of the Sawyer board it will only be necessary to refer to Figs. 1 and 2, representing respectively a front and back view, and a glance will enable the reader to understand its simple working.

One of the greatest difficulties experienced by the Chicago Arc Light & Power company, which operates a large number of dynamos and a great many circuits, was that of being unable to throw a circuit from one dynamo to another without stopping for a long enough period to cause serious complaints from customers renting arc lamps. After the installation of Mr. Sawyer's board, however, the changing over of circuits from one dynamo to another was accomplished so quickly as to be practically instantaneous and complaints ceased.

Fig. 2, the view of the back of the board, shows the extreme simplicity of the few working parts. The wires from the dynamos come into the board on the top and are fastened in the eight binding posts there shown. The circuits to the lamps come in on the lower half of the board and are attached, as shown, to the four sets of switch levers which, as will be seen at a glance, constitute what might be called movable terminals for each circuit. These circuit terminal switch levers, pivoted as indicated, have slotted ends each engaging with a pin set in a centrally pivoted piece of fiber. This piece of fiber, represented in the cut by pure black, is a little longer than it is wide and is fastened to the end of a journal which passes entirely through the board and carries on its outer end a keyhole.

Now, if a key A, Fig. 1, be inserted into the keyhole on the outer end of the journal and be given a twist, the action will be first, of course, to move the fiber block, which in turn acts upon the two switch levers and throws them from one set of two terminals into the jaws of the other two terminals of the set of four.

Bearing in mind that the four little metal pieces, Fig. 2, between which each set of switch levers hang, are sockets set in holes extending through the board, and into which (see Fig. 1) the cable plugs can be inserted, any man of intelligence who has manipulated an arc light switchboard will be able to understand the simple action of the Sawyer board.

To shift a circuit from one dynamo to another it is, of course, first necessary, Fig. 1, to connect by means of the plug cables the two dynamo plug holes at the top with the two circuit plug holes of the proper set at the bottom. Then to make the shift it is only necessary to give the key a twist and the shift is made.

The board illustrated is 6 feet high and the face of the board is of marble 30 inches by 40 inches. This size is adapted for four dynamos and four circuits, but it is perhaps needless to say that the Sawyer board can be furnished to fill the requirements of any sized station.

## Trolley Agitation in Chicago.

At the meeting of the Chicago council last Monday night Mayor Hopkins' veto of the trolley ordinances, passed by the council at the previous week's meeting, were presented. To the mayor the provisions under which the company is to give $150,000 to assist in defraying the expenses of track elevation seemed objectionable. The measure provided that the money should be paid in 13 installments as the railroad companies completed the subways of the streets through which the street railway ran its cars. The mayor said that the attorney for the street railway company had agreed to pay the money at once if the road were given the privilege of stringing its trolleys in Indiana avenue and Eighteenth street. With the addition of several minor amendments the original ordinance was passed. This ordinance gives the street railway company the right to string wires on Indiana avenue. The mayor also vetoed the north side electric ordinance. He proposed several amendments, which were accepted by the council, and the franchise was given to the company.

## A Chicago Electric Lighting Company Fails.

The Coöperative Electric Light company, with offices in the Owings building, Chicago, has made an assignment in the county court in favor of Jacob W. Richards as assignee. Assets were estimated at $200,000 and liabilities $100,000. The corporation was organized in 1888 to supply electric light to private individuals on the North Side. The plant of the company is situated at No. 359 North State street. The failure is attributed to the lack of ready funds and the pressure of a large creditor. Frederick S. Smith is president of the company and Percy L. Schuman, secretary. Judge Scales entered an order for the assignee to operate the plant pending a settlement with the creditors.

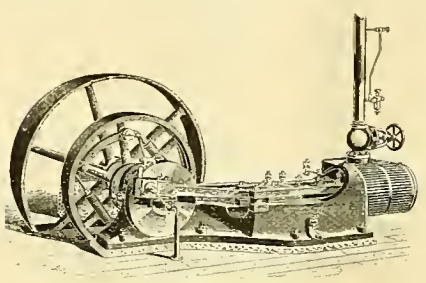
## Tangye-bed Automatic Cut-off Engine.

Appreciative of the fact that electric light and power service require a specially designed and constructed engine, the Erie City Iron Works of Erie, Pa., now wish particularly to call to the attention of electric light and power men their Tangye-bed automatic cut-off engine. This engine is designed for mills as well as for electric light and power plants; and, in fact, it is intended to be used under almost any condition where medium speed, very close regulation, and economy of steam are desired.

Without inflicting the reader with a description of a number of unimportant details, the chief claims advanced for this engine are as follows:

Simplicity and general symmetry, all the metal being so placed as to give the greatest stiffness and stability. On this engine there are, as the cut will show, a small number of working parts, and it is exceedingly easy to renew any one of them in case of wear or breakage. The engine has large wearing surfaces, all of which are proportioned upon the latest and most approved formulas taken from the highest standard there is on the subject. The steam ports of the engine are nearly equal in length to the diameter of the cylinder and are so located as to insure perfect drainage. The main journals are long and are fitted with patent quarter boxes. In fact all wearing surfaces are extra large; the crank pin, piston and valve rods are all steel. With reference to the bearings it may be said that there is employed in this engine a peculiar form of pillow block by which the alignment is kept perfect and its adjustment made by single screws, insuring uniform pressure upon the main bearings.

The design of governor employed in this engine is unique in construction. In this part neither of the two actuating eccentrics are keyed directly to the shaft, but are



TANGYE-BED AUTOMATIC CUT-OFF ENGINE.

held in rotatory suspension in a case having extremely large wearing surfaces and so proportioned that the eccentrics of these two are located within the periphery of the shaft of the engine, thereby insuring great rigidity and stability combined with extreme sensitiveness of motion. The company claims that all of its engines are thoroughly well made throughout, and all are tested under steam before shipment. These engines are made in sizes ranging from 45 to 350 horse power.

The Erie City Iron Works recently moved their Chicago office to 1510 Old Colony building, and at this address further information or catalogues may be obtained.

# CORRESPONDENCE.

## New York Notes.

New York, July 16.—Last Friday there was filed in the office of the secretary of state in Trenton, N. J., articles of incorporation of a concern having for its object the connection of New York and Philadelphia by trolley lines. The capital stock is $10,000,000. This scheme, which was outlined in the columns of this journal some months ago when it was first made public, is one of the most important of its kind. It is not merely a single trunk line running by the nearest route between New York and Philadelphia, but a large system of roads, affording accommodations both for travel and for traffic of the several millions of persons between those cities.

The direct line of the main stem commences at Paterson, where connections will be made with the street railway system of that city. Leaving Paterson the road will pass through Upper Montclair, Montclair Bloomfield, Orange, East and West Orange, South Orange, Maplewood, Wyoming, Springfield, Westfield, Fanwood and Netherwood to a connection with the present electrical railway system in Plainfield, and thence through Plainfield to Bound Brook. Crossing the track of the New Jersey Central railroad at Finderne, the road will continue past Hillsboro station on the Lehigh Valley railroad, and Weston Station, on the Philadelphia & Reading, and thence to Millston, Rocky Hill, Princeton, Lawrenceville and Trenton. Branches will run from Bound Brook to New Brunswick, Somerville and and Raritan; from Bloomfield to Irvington, and to Morristown by way of Chatham and Madison. At Irvington connections will be made with the existing lines of the Traction company, making a direct route to Newark and Jersey City. From Westfield the road will be built to Rahway, connecting there with the electric railway now being constructed to Lebanon and Boyton; South Beach, with a spur from Woodbridge to Perth Amboy. Another branch will be built from Rahway to Elizabeth, connecting there with the Consolidated company's system; also a branch from Bound Brook to New Brunswick, connecting there with the present street railway. From Trenton the road will pass through Morrisville, Bristol, Carnwells, Terresdale, Tacony, Holmesburg and Frankfort, connecting at the latter point with the existing line into the heart of Philadelphia. It will also connect at Trenton with a line to Camden, running almost parallel with the Amboy division of the Pennsylvania railroad, and passing through Bordentown, Palmyra, and thence into Camden by existing lines.

The entire system will comprise about 1,000 miles of track and will, it is estimated, accommodate 5,000,000 persons. It is designed not only to carry passengers, but to transport by means of combination trains farming truck, agricultural implements, manufactured products, general merchandise and all such goods as enter into local commerce. The electric enterprise is to be managed by two great corporations—the Central Jersey Traction company, with a capital stock of $500,000, and headquarters at No. 2 Wall street, New York, and the New York & Philadelphia Traction company, with a capital stock of $10,000,000, and general offices at Trenton, N. J. The officers and directors of the first named company are: President, Frank A. McGowan; vice-president, ex-Sheriff E. W. Hine of Newark; secretary, J. H. Baldwin of Newark; treasurer, J. H. Darral of Trenton; directors, D. K. Bayne of New York, W. H. Skirm of Trenton, Joseph H. Reall of Bloomfield, and J. C. McNaughton of Philadelphia. One of the interesting features of the scheme is the utilization of the water of the Delaware river for motor power. Frank A. McGowan is at the head of a syndicate that has secured partial right to use the falls of the Delaware at this point to furnish electrical heat, light and power for an area of 30 miles around Trenton. The plant is to be at Morrisville, Pa. In anticipation of enormous operations, the company has purchased much of the water front on the Pennsylvania side, and is prepared to erect a big power house.

The Nassau and Kings County Electric Railway companies, of which Patrick H. Flynn is the president, scored a point in their favor Thursday, Judge Brown of the supreme court, Brooklyn, having handed down a decision refusing the application of John Adamson for an injunction to restrain these corporations from building trolley lines under the franchise granted by a former board of aldermen. This decision practically permits the construction of 32 miles more of the trolley surface system of railroads in that city. The action was brought by Mr. Adamson, who sought to prevent a waste of the funds of the city.

At last week's meeting the Rapid Transit Commission passed resolutions declaring that it stood in favor of the plans prepared by the former commission for an underground road. The commission's desire is for a speedy settlement of the question of municipal construction. After that is decided it will provide a plan for the East Side, which will take the place of the one which the property owners af Madison avenue rendered impossible when they secured the passage of the law of 1892, providing no road should go under, on or over Madison avenue. Practically the action of the commissioners was to adopt the plans for an underground system of their predecessors, leaving open for consideration, after the people has voted upon the general questions, a scheme for rapid transit north of Forty-second street on the East Side.

W. F. O.

## PERSONAL.

B. J. Arnold has removed his office from the fourth floor of the Rookery, Chicago, to 576 the same building.

William H. McKinlock, president of the Metropolitan Electric company, Chicago, has returned from a flying business trip to New York.

H. C. Porter has taken offices in the Bort building, Chicago. Mr. Porter has been east for some time in the interest of the Globe storage battery.

Edward R. Grier of the firm of Grier Brothers, western representatives of the Bryant Electric company, has gone east to visit the company's factory at Bridgeport, Conn.

A dispatch from Berlin, dated July 14th, states that Prof. Herman von Helmholtz, the distinguished German scientist, who was taken suddenly ill July 12th, is suffering from paralysis of the left side.

Prof. Ludwig Boltzmann of Munich has been offered the chair of physics at the Vienna University made vacant by the death of Prof. Stefan. Prof. Kaiser of Hanover is to be the successor of Hertz at Bonn.

## MISCELLANEOUS.

A new engineering publication, the *Illustrated Technical Magazine*, is shortly to make its appearance in London. It will be published monthly, each issue consisting of 64 pages. The idea is to treat engineering subjects in a popular manner, something after the style of the *Engineering Magazine* and *Cassier's Magazine* in this country. Illustrations will be made a prominent feature.

Among the fine office buildings in Chicago the Marquette building, now in process of construction at the corner of Adams and Dearborn streets, will take a place in the front rank. Particular attention will be paid to its electric lighting, and a contract has been secured by the Chicago Edison company for furnishing current for 5,132 incandescent lamps. The wires will be concealed throughout in brass covered interior conduit, and it is stated that this is the highest priced contract ever let in Chicago for office building wiring. Another contract which the Chicago Edison company has recently secured is that for wiring for 1,527 lights in the Reliance building, which W. E. Hale is building. Both of these buildings will be supplied with current from the down-town stations of the company.

The following "after dinner phenomenon" was noted recently in the London *Electrician:* When the guests adjourned to the engine room of the Portsmouth electric supply station after the inaugural banquet, they found one of the alternators at work, and the place brilliantly illuminated by the arc lamps. The other alternator was then started, and the massive flywheel, crowned with a diadem of glittering copper coils, began to smoothly turn, gradually quicken, and finally spin round at full speed. But as it did this, the bystanders were amazed to see the rim slowly revolving the wrong way, while the crank and piston rod were running on without change. In another moment the field magnets stopped, and then began to turn the right way, but leisurely. Again they reversed, and finally stopped. Some of the guests gave vent to expressions of amazement; but the more cautious, remembering the good things generously provided by the mayor, rubbed their eyes, clutched a handrail and held their tongues. It is only necessary to add that the rectified current, giving, as it does, one hundred flickers per second, shows a series of momentary glimpses of the armature, which, if running synchronously, appears stationary, and if a little slow or fast, seems to revolve backward or forward.

## BUSINESS.

The Pumpelly-Sorley Storage Battery company has removed its offices to 574 the Rookery, Chicago.

Montgomery Waddell, receiver for the Waddell-Entz company, has petitioned the Superior Court in Bridgeport, Conn., for permission to lease the plant of the company to E. P. Bullard of Bridgeport, Conn., until February 1, 1895.

Word has been received from Manager J. S. Speer, of the Partridge Carbon Works, Sandusky, O., to the effect that his factory is now running full time and has a good stock of orders on hand. It is stated that where the Partridge carbon brushes are used they are giving excellent satisfaction. This company has done good work in pushing its goods throughout the United States and there are few electric roads which do not know the merits of the Partridge carbon brush.

The General Incandescent Arc Light company, New York, has received a most flattering testimonial from a New York concern, in whose establishment the company installed about 500 lamps. These lamps have been in operation for some time, and, according to the testimonial letter, have been giving the best of satisfaction. It is said that this installation, which is in the building of Hilton, Hughes & Co., New York, is the largest installation of low tension arc lamps in one building in existence. The company feels that it has abundant reason to feel satisfied over its success.

All users of colored and frosted incandescent lamps have undoubtedly frequently suffered considerable inconvenience from inability to get their orders for fancy goods filled promptly from stock. The Electric Appliance company, Chicago, appreciating the fact that some arrangement ought to be made by which delays of this kind could be obviated, has perfected plans for frosting and coloring lamps of all kinds in Chicago and has established a coloring room for doing this work, and is now prepared to furnish colored and frosted lamps promptly on receipt of orders. By the use of improved coloring compounds and methods of treating, results have been secured in colored and frosted lamps fully equaling those obtained from genuine colored and frosted glass and of course at a very much less cost.

The Ohio Brass company of Mansfield, O., is now making a new design of the Westinghouse type of trolley wheel, in which oil is used as a lubricant for the steel spindle, in addition to the graphite bushing. The center of the hub of the wheel is hollowed out around the graphite bushing and the recess filled with felt packing. Holes are provided so that the felt may be saturated with oil, which, in turn feeds through the graphite bushing onto the spindle, keeping the graphite moist and lubricating the bearing thoroughly. The company asserts that this adds about 25 per cent. to the life of the wheel. It is advisable to pour a few drops of oil into the oil well every few days. These wheels are made of extra hard quality bronze metal and proportioned so as to give the longest possible wear. They are balanced and true, and in consequence will run smoothly on the trolley wire.

The Metropolitan Electric company, Chicago, reports one of the largest sales of wire that has been made in the West for some time. Last week it closed the contract for 200 miles in one order. The lack of shipping facilities has been a source of annoyance to all of the electrical supply houses, and the Metropolitan company has been no exception, but now that railroad companies no longer refuse to accept freight the prospects of a heavy rush of orders are good. Prominent among the specialities which this company handles is the Kester arc lamp for alternating circuits, which, however, is also used for direct current work. These lamps, since the Metropolitan company took the general western agency for the manufacturer, the F. P. Little Electrical Construction & Supply company of Buffalo, N. Y., have been meeting with much favor. A full line is upon exhibition in the company's store upon Fifth avenue, where their neat appearance and reputation for efficient service prove strong factors in their sale. Each lamp before it leaves the Buffalo factory is thoroughly tested and personally inspected by Mr. Kester, thus practically insuring its capacity for successful operation. Another specialty which is arousing much interest is the battery and fan motor outfit manufactured by the Knapp Electrical Construction company of New York. For places where it is not possible to utilize current from a line this outfit is of much value. It consists of three jars of battery contained in a small wooden case and a motor, all designed to take up the least possible room. The Metropolitan Electric company has made these outfits a feature of its summer fan motor business, which has been very satisfactory.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued July* 10, 1894

522,580. Dynamo-electric Machine. Louis Bell, Lynn, Mass.

The inventor has designed a dynamo-electric machine having the adjacent faces of its armature and field magnet provided with coil chambers, teeth and channels of such shape and so arranged that the reluctance of the magnetic path through them in the various relative positions assumed during rotation will be kept substantially constant.

522,581. Controller for Electric Motors. John B. Blood, Lynn, Mass.

The invention is especially applicable to electric railway cars. By its means the use of a reversing switch in connection with the controller is obviated by having the controlling switches at opposite ends of the car cross connected, so that the operation of one of the switches causes the car to move in one direction while the other switch controls its movement in the opposite direction. Further cross connections are provided, however, at each switch, by means of which a backward movement of the car may be accomplished by a backward movement of the switch in use. The switch handle is provided with a locking device, which renders it impossible for a motorman to suddenly reverse the switch by pulling the handle back until the cross connections are connected by the switch contacts. An auxiliary locking device prevents the removal of the controlling handle from the switch arm, except when the switch arm is in the neutral position with no current passing through the motors, and its removal at this point automatically locks the switch arm in this position, so that it is impossible for an unauthorized person to tamper with it.

522,597. Electric Switch. Joseph Hutchinson, New York, N. Y.

More especially the object of the invention is to provide a simple and compact form of switch which can readily be put in place upon an electrolier arm by those who manufacture and install such fixtures.

522,621. Combined Hanger and Automatic Switch for Trolley Wires. Rupert Schefbauer, Paterson, N. J.

The object of this invention is to provide a combined support and switch for the trolley wires of electric railways, which is so constructed that whenever the trolley wire breaks the current is immediately switched off from the broken part of the wire.

522,632. Circuit Closing Device. Philip J. Walsh, Jr., Philadelphia, Pa.

The invention comprises a supporting base plate, a tongue or block, a spring acting on the block and a terminal carried by the block, a second terminal with which the first terminal is normally held in contact by the action of the spring.

522,655. Conduit Railway Trolley. John L. Creveling, Auburn, N. Y.

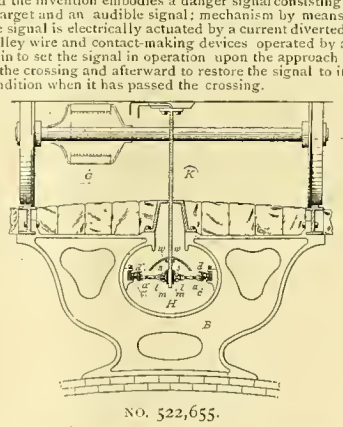
In the drawing is represented a traverse view of a roadway. The central openings *H*, through the successive yokes *B*, form a conduit within which the two line wires *a a'* are carried. These line wires are secured to the brackets by bolts, and are secured within the insulating blocks *c c'*, while covers *d d'* protect them from moisture dropping upon them. The trolley consists of a vertical plate *K*, secured beneath the frame of a car truck, and extending downward into the space *H* as shown. At the lower part of this plate and at each side thereof a slide *l l* is secured, and insulated by a layer of non-conducting material *m*. A pair of arms on either side is pivoted to a portion of the slide *l* and to a block *s*, which is fitted to slide on the way *t*. Trolley wheels are pivoted to the outer ends of the arms, and the wheel is kept in close contact with the wire *a* by the spring. A hood *w w* protects these parts from moisture from above. Insulated wires are led from the slide *l* on one side, up through the central plate *K* to the car motor *G* and returned through the central plate to the slide *l* on the other side.

522,664. Electric Distribution Box. Oscar D. Kleinsteuber and Monroe A. Kleinsteuber, Milwaukee, Wis.

The invention has for its object to improve a former patent granted to the inventors. The device consists of a suitable box containing an insulating base and a series of pairs of contact sections having arms extended through the insulating base to be electrically connected with strands of cables, each pair of contact sections being electrically connected or disconnected at will.

522,670. Danger Signal for Railway Crossings. Myron W. Parrish, Detroit, Mich.

The invention is especially intended for the crossing of an electric railway track with an ordinary railroad track, and the object of the invention is to set a danger signal for the electric railway by a railroad train approaching the crossing. To this end the invention embodies a danger signal consisting of lights, a target and an audible signal; mechanism by means of which the signal is electrically actuated by a current diverted from the trolley wire and contact-making devices operated by a passing train to set the signal in operation upon the approach of a train to the crossing and afterward to restore the signal to its normal condition when it has passed the crossing.



NO. 522,655.

522,674. Electric Meter. Gustave A. Scheeffer, Peoria, Ill.

The invention relates more especially to the class of electric current meters in which an unwound magnetic armature is employed, and is magnetized by coils so as to produce diametrically opposite poles, and in which the armature so magnetized is contained in a magnetic field induced by other coils from which arrangement movement results. The invention consists in the particular construction of the multipolar magnet, in which are employed three polar projections or magnetic surfaces, the two outside legs being wound, one with a coil in series with the load to be measured and the other with a fine wire coil in shunt with the load, and the other limb or magnetic surface of the magnet without any coil, the polar projections being so formed as to provide for the turning of a metallic cylinder in inductive proximity to the polar projections.

522,680. Electric Arc Lamp. Moses S. Okun, New York, N. Y.

The objects of the invention are to provide efficient and sensitive mechanism for striking the arc when the current is turned on to the lamp, and for continually maintaining the carbons at the proper distance apart; to provide simple and effective devices for closing substantially air tight the globes of electric arc lamps, so that the arc may be formed in a gas which will retard the combustion of the carbons; to provide for the proper operation and adjustment of the carbons within the globe while closed; to provide means by which the carbons may be permitted to have some lateral motion with relation to the globe when necessary without binding or cramping of the carbons, and without danger of admitting air to the globe; to provide means for permitting the escape of surplus gas when the pressure within the globe becomes too great; to prevent as far as possible the throwing of shadows by the carbons of the lamp, and to provide a carbon holder which may pass freely through an aperture in a disk or cover on the globe or through the globe, so that as much as possible of the carbon pencil may be utilized, and to so construct this carbon holder that air may not be admitted to the globe when it passes through the aperture.

522,690. Electric Lamp Holder. Martin P. Meyer, Rochester, N. Y.

The invention has for its object to provide an improved holder for electric incandescent lamps embodying a lamp guard and shade or reflector in which all the parts are insulated and protected, so that there is no danger of a person receiving an electric shock by coming in contact with the shade, guard or any other part of the device.

522,707. Telephony. Frank R. Colvin, New York, N. Y.

This invention relates to telephony, the object being to provide a simple and inexpensive device for cutting out the bell or other calling instrument when the telephone is in use.

522,709. Contact Shoe for Electric Locomotives. John J. Green, Boonton, N. J.

The contact shoe patented comprises a flexible or yielding central bar, flexible metallic side strips and end pieces of insulating material loosely attached to the central bar and the side strips. The invention also embodies novel features of construction by which the shoe is left in the conduit without injury thereto should the car from any cause become derailed.

522,710. Contact Bar for Electric Locomotives. John J. Green, Boonton, N. J.

This shoe consists chiefly of two contact plates held parallel by spacing pieces at intervals without any longitudinal bar or supporting piece between them, so that the plates only have to be bent when the shoe is passing curves in the conduit, the spacing pieces or blocks and the rigid and sliding connections being so arranged as to insure the contact strips curving regularly and maintaining parallelism.

522,711. Supply System for Electric Railways. John J. Green, Boonton, N. J.

A shoe for electric railways having contact plates or strips with side contact faces arranged in or about the same vertical plane, one above the other, is the subject of the patent.

522,718. Electric Heater. H. Ward Leonard, New York, N. Y.

The inventor claims in a device in which electric energy is converted into heat, the combination of a conductor, an insulating covering for such conductor of a minimum thickness necessary to electrically insulate it, and a comparatively large mass of metal closely applied to and surrounding the insulated conductor throughout its entire length.

522,724. Electric Synchronizer for Clocks. Ludwig von Orth, Berlin, Germany.

In a timepiece the combination of the pendulum of a verge rod provided with a pivoted lever, one arm of which is bent and engages a pin on the pendulum rod, and the other arm is provided with teeth, an armature lever adapted to engage with the teeth on the arm, an electro-magnet arranged to act on the lever, a cam and an arm adapted to engage the cam.

522,727. Electric Lamp Lighter. Josephus C. Chambers, Detroit, Mich.

An electric lamp lighter especially designed for a cigar lighter is described.

522,733. Electric Door Opener. Henry F. Keil, New York, N. Y.

The invention relates to an improved electric door lock opener, in which the locking jaw is released by the aid of electro-magnets, and the object of the invention is to overcome the many difficulties now experienced in electric door openers in which the mechanism becomes disordered by reason of the complexity of their construction.

522,735. Electric Arc Lamp. Peter Kirkegaard, Brooklyn, N. Y.

The invention has for its object to produce a lamp with a simple and efficient regulating mechanism in which the dash pot or other cushioning device to prevent hammering is dispensed with. Another object is to cheapen and improve the construction of the lamp box or casing, and a still further object is to produce a simple and efficient carbon holder which shall occupy a small amount of space.

522,745. Insulating Composition. James L. Truslow, Jr., Summit, N. J.

In preparing this insulating composition waste pieces of cork are ground as fine as possible. Ninety parts of ground cork are then placed in a suitable vessel and mixed with about five parts of resin, and with infusorial earth also five parts. The mass is heated while the mixing takes place, so that all the parts are intimately united. While the mass is still hot it is removed from the heating vessel, run into a suitable mold and pressed into any suitable shape. The volatile products of the resin are permitted to escape during the heating of the mass, care being taken that the material contains a sufficient quantity of resin, so that the required strength of compactness and cohesion is imparted to the material.

522,757. Device for Preventing Railroad Collisions. Charles Holtmann and Nickolaus Schmidt, Pittsburg, Pa.

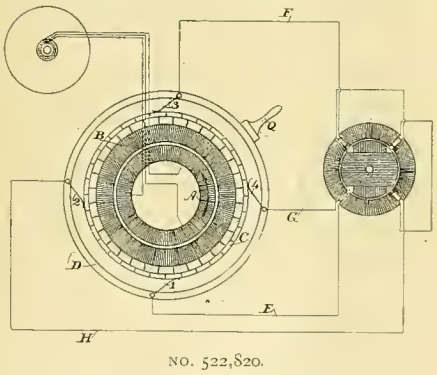
The invention has reference to an improved automatic device for operating air brakes to prevent collisions on railways, and it consists in a track battery for each block and an instrument or apparatus in connection with the ordinary air brake which will set the brakes should any two trains enter one block at the same time, together with certain details of construction and combination of parts.

522,790. Electric Arc Lamp. Edward F. Gwynn, Delaware, O.

The invention embodies in an electric lamp, a carbon-sustaining rod, suitable gearing for operating the carbon rod to feed the carbon, the gearing being supported on a movable lever controlled by a magnet in the main circuit, and a friction clutch arranged in the gearing, and a stationary device adapted by the movement of the lever to operate the friction clutch and thus disengage the carbon rod from the gearing to permit the carbon to feed independent of the gearing.

522,820. Means for Regulating Alternating Current Motors. Edward M. Bentley, Boston, Mass.

There are employed for the purpose of this invention a transformer between the main line and the motor, the primary of which has a ring-shaped core in which the rotation of the magnetic poles is accomplished in a well known manner by multiphase currents. The secondary is substantially a Gramme ring provided with a commutator, and the secondary current is taken from this commutator by means of brushes, which are fixed so long as the motor is receiving currents of the same phase periods as those in the primary, but which may be rotated in one direction or the other according as it is desired to have the phase periods of the motor current longer or shorter than those in the primary. Thus, when it is desired to start the motor or run at a speed different from that which naturally would be imparted by the line impulses, the brushes may be rotated in either direction at a speed adapted to produce the desired phase periods in the motor circuit. The system is illustrated in the accompanying drawing. *A* being the primary of a transformer, *B* the secondary provided with a commutator *C*, *1*, *2*, *3*, *4* being a series of brushes secured to the ring or disk *D*, which is adapted to be rotated in either direction by the handle *Q*; *E*, *F*, *G*, *H* are mains leading to the motor.



NO. 522,820.

522,834. Electric Locomotive. Edward Hopkinson, Manchester, England.

It is proposed that the revolving armature of the motor should be built on one of the axles of a vehicle so as to avoid all intermediate gearing, as shown in the illustration. To facilitate the application of this method the inventor carries the magnets and pole pieces of the motor dynamo, between which the armature revolves, wholly or in part directly from the axle, supporting their weight on sleeves, bearings or journals in which the axle revolves. In many cases the most convenient position for the magnet is such that they are in the same horizontal plane as the axle, or approximately so. Their weight must then be supported in part from the framework of the vehicle, and a portion only of such weight will rest directly on the axle through the journals. The support from the framework may in this case be conveniently effected by a spring or link which will allow certain limited freedom of motion of the magnets and pole pieces round the axle as an axis. In all arrangements the magnets and pole pieces may have limited freedom of motion through a small angle round the axle, but this motion being circular only the armature which revolves with the axle must always remain central in the fields or pole pieces. By this means any rising or falling of the frame is compensated for by the angular movement of the magnets and pole pieces, and the jar and vibration in starting are largely absorbed by the spring stops or buffers. The invention is also applicable to geared motors, but in such cases the entire motor-dynamo, including the armature, is slung from the axle and is free to move about it, except in so far as its motion may be restricted by guides or stops. The shaft of the motor is then geared to the axle, which may be done by any of the familiar devices.

522,835. Electric Crane. Edward Hopkinson, Manchester, England.

The invention consists in mounting the motor on one of the axles of the carriage of an electric crane, the armature being built on the axle, and the field magnet being supported in such manner as to have freedom of angular motion around the axle, and in combining with the motor, clutches or equivalent means for connecting the axle with the traveling wheels or with the lifting barrel at will, so that the same motor can be used for both traversing and lifting.

522,836. Galvanic Battery. Louis F. Johnson, Poughkeepsie, N. Y.

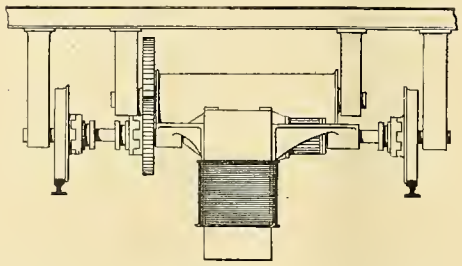
In addition to a peculiar construction of cell the inventor claims an electrolyte for galvanic batteries composed of sulphuric acid, water having chromate of calcium dissolved therein, and nitric acid, the components being unmixed and arranged in the cell in the order named.

522,837. Current Separator. Louis F. Johnson, Poughkeepsie, N. Y.

It is the object of this invention to provide a simple, compact and inexpensive apparatus that can be placed in every signal tower or in any other place upon the line of a lighting circuit and by means of which current from the lighting circuit may be supplied at such times and in such proportions as may be required for the operation of various local circuits.

522,844. Trolley Ear. Charles A. Lieb, New York, N. Y.

A trolley ear having a sheet metal portion with an upwardly extending fin or fold, and a cast metal bolt portion secured to the fin or fold is described.



NO. 522,834.

522,845. Trolley Wheel. Charles A. Lieb, New York, N. Y.

The inventor employs a copper or bronze core for the trolley wheel and provides it with thin sheet steel flanges properly secured thereto, and these flanges he provides with radial corrugations extending nearly to their rims, so that when the bearing surface of the flange is worn, the corrugations will still serve to support the rim of the flange so that it will not drop off and permit the trolley to run off the wire.

522,851. Motor Safety Device. Arthur W. K. Peirce, Plymouth, Mass.

The aim of the invention is to guard against injury to electrical apparatus included in a circuit of high self-induction arising from the extra discharge of the circuit when broken. A shunt circuit for the discharge through a resistance non-self inductive in character is provided, and the present improvements consist principally in providing an auxiliary switch in the shunt circuit which is connected with or operated by the main circuit switch in such a way that when the main circuit is closed the shunt circuit is opened, and at the time when the main circuit is opened, or better, just before rupturing the main circuit, the shunt circuit is closed so that the discharge may take place in the shunt circuit, thus guarding against injury to the protected apparatus in a manner well understood.

522,859. Insulated Armature Coil. John H. Shugg, Boston, Mass.

A coil for the armature of a dynamo electric machine or motor the wires of which are bound together with tape, and insulated with a layer of oiled linen and an outside wrapping of tape impregnated with an insulating varnish is described.

522,865. Current Interrupter for High Potential Circuits. Elihu Thomson, Swampscott, Mass.

The invention aimes to extinguish by a blast of air the arc formed when the circuit is broken upon high potential currents. A spring drum for separating the terminals is used, the drum operating to reel up a flexible conducting cable to which one of the terminals is attached. It is preferred to so arrange the apparatus that the winding up of the cable actuates the air pump for giving the blast.

522,892. Telautograph. Elisha Gray, Highland Park, Ill.

A spring is provided in the telautograph between the motor or other source of power, and the receiving pen, which spring shall be put under tension by the motor, the tension of the spring driving the receiving pen. Thus a more instantaneous motion is possible. To provide for the constancy of the force of the spring a motor or other source of power which is controlled in its application to the spring by the tension of the spring itself is provided, so that when the spring reaches the desired degree of tension the further action of the motor upon the spring is suspended until the tension of the spring falls below the normal amount of tension, when the motor acts to again increase the same.

522,893. Telautograph. Elisha Gray, Highland, Park, Ill.

The invention has for one of its objects to simplify and improve the mechanism for transmitting the power from the power mechanism to the receiving pen in the telautograph. The inventor finds that the best form of spring for this purpose is that which is given its tension by torsional movement; also that a direct acting motor, by which is meant a motor acting through gearing upon the shaft from which the receiving pen is driven, is more satisfactory in this operation than one in which the connection is made through a ratchet and pawls. The invention further consists in mechanism by which a single motor is applied to driving the parts of the receiving instrument through an equalizing gear and two springs. It also consists in improvements in the reversing mechanism by which the action of the latter is rendered more quick and certain, and in other details and features of construction.

522,894. Closed Conduit for Electric Railways. Charles I. Greer, Washington, D. C.

Two of the principal objects of this invention are to provide in a conduit electric railway a slot cover formed in separate rigid sections pivotally linked together in such manner as to permit the rise of the rigid sections successively, with but little disturbance or displacement of the two adjacent sections, which will be caused to assume such a position that the trolley may readily pass beneath the end of the section in advance, and raise the latter in its turn, while the adjacent end of the section in rear is dropped upon the slot without material shock or noise; and to provide a cover for a slot consisting of rigid, pivotally linked sections, having central webs which are adapted to lie in central longitudinal channels in sectional cores or filling blocks and serve as guides in restoring the sectional cover to place, as well as to prevent any lateral displacement, the construction being such that the webs are never entirely withdrawn from the channels in the cores or filling blocks.

522,896. Hanger for Electric Lamps. Henry C. Henley, St. Louis, Mo.

A hanger for electric lamps, adapted for application to a pendant gas pipe, or other such pipe in the ceiling of a room, or similar position is the subject of the invention. The hanger affords complete insulation between the house pipe system and the electric lamp. A further object of the invention is to prevent short circuiting by the passage, from one part of the hanger to the other, of the water which commonly condenses in gas pipes.

522,915. Trolley Pole. Alexander S. McBean, Montreal, Quebec.

The invention embraces improvements in trolley poles for electric cars, and provides means by which the trolley wheel will be at liberty to adapt itself better to the curves and other divergences of the overhead wire.

522,919. Electric Cigar Lighter. Charles F. Reiff and Henry Munk, Fremont, O.

By raising a handle perpendicularly a tube automatically falls back causing an electric wire spring to come in contact with a platinum point at the top of another tube, connected with the handle, which drops an electric spark on a wick in the second tube causing it to ignite.

522,925. Operator's Telephone Circuit. Thomas C. Wales, Jr., Boston, Mass.

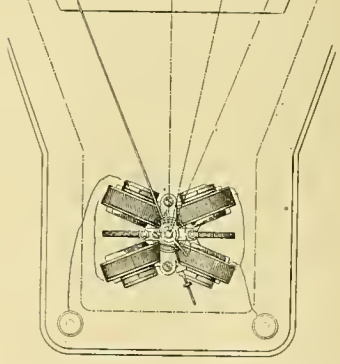
In carrying out his invention the inventor associates the receiving telephone with the transmitter primary circuit, in a derivation or branch in parallel with, or as a shunt of the primary helix of the transmitter induction coil, and so proportions the size and length of the wire which constitutes the telephone receiver coil, that its impedence properly corresponds to the impedence of the primary helix of the transmitter induction coil. By means of the new circuit arrangement and definite proportionment of impedence, it is possible to use a head telephone with but a single and one part helix, essentially similar in construction to standard instruments.

522,934. Electric Cigar Lighter. John J. Eberhard and Carl G. Schimkatt, Fremont, O.

The inventors claim among other combinations in a cigar lighter, the combination of a frame comprising a cross bar and two depending members of a lamp pivotally and adjustably secured at the lower ends of the members, the center of gravity of the lamp being below the pivotal point, and means for automatically forming an electrical spark when the end of the lamp and the frame are disconnected.

522,948. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

The invention relates to an electrical measuring instrument in which a movable coil is caused, by the mutual reaction of its field with that of a stationary or fixed coil, to vibrate and cause a movement of an indicating apparatus, the extent of which bears a relation to the potential difference existing between the instrument terminals, so that either current strength or pressure may thus be measured. It consists more particularly in the construction and arrangement of apparatus wherein two coils, supported and equilibrated on the arms of a vibrating lever, are interposed between fixed coils, and in an exceedingly strong field; whereby the force applied to the coils is a couple tending to oscillate the lever on its fulcrum against the constant resistance of a suitably disposed spring, by means of which spring the actuating force is weighed. The extent of deflection of the lever or of a pivot shaft on which the lever is supported is indicated by an index moving over a scale graduated in suitable units. The accompanying illustration shows a face view of the instrument which is preferably secured to a vertical support.



NO. 522,948.

522,949. Watt Meter. Edward Weston, Newark, N. J.

This invention is an instrument for effecting the simultaneous measurement of the current and potential difference, and therefore of indicating the watts on a circuit directly whether the current on the circuit be direct or alternating. It embodies two coils, one fixed and the other movable, of which the fixed coil is placed in main circuit of low resistance, using a thick wire and including the lamp or other object in which the expenditure of energy is to be measured, and the movable coil is arranged as a shunt to the fixed coil, which shunt includes a relatively high resistance. The movement of the movable coil is counterbalanced by a coiled spring which also serves to lead the current to the coil. By reason of this construction no manual interference is necessary to produce equilibration between the fields generated in the coils; the movable coil turning on its pivots and finding its own equilibration, so that in this way the watts are directly measured and indicated on the scale of the instrument.

522,950. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

The invention relates to electrical measuring instruments used in connection with a switchboard, on what is known as the "edgewise" system, wherein the scale and index needle instead of being disposed on the face, are arranged on the edge of the instrument. It consists more particularly in the construction of the instrument and its combination with a supporting frame, or with the switchboard so that its position may be varied in order to enable the indications to be conveniently read, and so that it may be held as adjusted.

11,428. Electric Signaling Apparatus. John P. Coleman, Swissvale, Pa.

This invention for which a re-issue is granted relates to an improvement in electrical apparatus for railroad signals, which consists of mechanism operated electrically from a distance, either automatically by action of a passing train or otherwise, so that when there is a break in the electric circuit in which the slot is included the parts are so moved that the semaphore is brought automatically into a "danger" position, and the connection with the mechanically operating parts of the semaphore is disjoined, so that it cannot again be brought into a position of "safety" until the electric circuit is again established.

# Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, JULY 28, 1894. No. 4


## Electric Launches in Chicago Parks.

The popularity of the electric launches navigated by the Electric Launch & Navigation company at the World's Fair last summer was of a pronounced character. These launches attracted much attention not only in this country, but among visitors from across the water as well, where several of them are now in operation. It is not strange, then, that the park commissioners of Chicago in two instances should have decided to retain a number of them for use upon the lagoons and lakes in the city parks. The lagoons of Jackson Park, although denuded of the magnificent structures which surrounded them before the final destruction of the white city, have at no time missed the presence of the noiseless, swiftly-moving boats, for the South Park commissioners, shortly after the close of the fair, purchased five launches from the company which enjoyed the launch concessions during the period of the exposition. These boats make regular trips from the charging station, which has been established in front of the woman's building, where there was located a station during the fair. Launches may also be chartered by pleasure parties for an evening, and are proving in this particular very popular, even a trip among the ruins by moonlight possessing a sort of melancholy interest to those who can recall the imposing scenes before fire and wrecking workmen destroyed the familiar spectacle.

FIG. 1. ELECTRIC LAUNCHES IN CHICAGO PARKS.

A sixth electric launch, an illustration of which is presented upon this page, Fig. 1, was purchased from the Japanese Ho-oden upon wooded island. This curious specimen of oriental fancy was upon the lagoons all of last summer, and its remarkable appearance was the source of amusement to fair visitors, for, as seen by the picture, its prow consists of the image of a large water-fowl imported from Japan, which, while possibly in accordance with Japanese ideas of symmetry and grace, falls short of American practice in launch architecture. Hoomaru is the name which was originally given it by its Mongolian owners, but its beak has earned for it the title of the "Rooster" among the irreverent launchmen. The body of the boat was built in Waukegan especially for the Japanese. It is broad and ill balanced, the stern being too much out of the water under ordinary circumstances to allow the screws to operate advantageously. Boards covered with matting conceal the storage batteries placed in the bottom of the boat, as well as the motors, and in place of a steering wheel an old fashioned rudder with a long handle is used. The passengers are protected from the weather by a large awning, matching the red and old gold trimmings of the frame of the boat. The "Rooster" possesses more than passing interest from the fact that it is a twin screw electric launch. Two one horse power shunt wound Lundell motors, run in series, and with their fields in parallel, are connected to two shafts, each of which revolves a three bladed screw under the stern. Controlling mechanism is placed within easy reach of the man at the rudder. The motive power is at present furnished by 24 150 ampere hour American cells, connected in series.

The charging station in Jackson Park comprises some features which differ from ordinary practice and which are worthy of note. Current is supplied from the South Park station on Cottage Grove avenue, over a mile distant. The existing overhead line of No. 6 wire is to be replaced by an underground circuit as soon as practicable. At the station, which was described and illustrated in the WESTERN ELECTRICIAN of November 26, 1892, there are six 50 light Brush arc machines supplying current for Washington Park and the boulevards. At eleven o'clock in the evening the current is shut off from the park and two dynamos are thrown in parallel for charging purposes and for supplying four arc lamps in the charging station. The batteries in the six launches are charged in series. The electrical equipment of these boats has been described in this journal in connection with their service during the World's Fair; in addition to that apparatus a double throw eight-bladed knife switch has been added to each boat for throwing the cells in series. Each launch, excepting the Hoomaru with its 24 cells, has 60 cells, so that 324 cells are thrown in series to be charged at the same time. One-half the current from the main line is shunted through resistance to the boats, the other half supplying four arc lamps. Each cell taking 2½ volts, the lamp approximately 200 volts, and allowing 40 volts loss on the line, the current at the machines is practically 20 amperes at 1,050 volts. The switchboard is shown in Fig. 2. At one side may be seen a portion of the resistance. The board includes two Edison ammeters, one for the main line and the other for the shunted current, six plugs and a Queen & Co. voltmeter for testing each launch, two arc light cut-outs, six Cleveland cut-outs for cutting out the launches, two wood cut-outs, one for the line and one for launch cut-outs, a switch for throwing on and off resistance, a switch for controlling a signaling system between the generating and charging stations, and a signal gong and relay used upon the system. The board is five by seven feet.

The signaling system employed between the two stations, to which reference has been made, is somewhat unusual, as communication is had over the charging circuit. In Fig. 3 is presented a diagram, which, in connection with the switchboard apparatus shown in Fig. 2, at one side of the charging apparatus, will give an excellent idea of the system. The circuit *A* entering the switchboard is tapped and as illustrated by the diagram, connected to ground. A telegraph key, a relay and 20 115 volt lamps wired in series for resistance enables the charging station to communicate with the generating station and regulate the operations there. A number of primary batteries furnish current for signaling when the lighting current is not on.

Many of the special applications in the charging station, including the eight-pole switch used on the electric launches for throwing the cells in series were designed and installed by W. F. Matteson, the electrician in charge of the station. Mr. Matteson has been obliged to contend with a series o

difficult problems and the success of this rather unusual installation is due principally to him.

Visitors to Lincoln Park can also enjoy a ride in electric launches, there being four of them now in service. The launches really attract the most attention in Lincoln Park, owing to the fact, undoubtedly, that their presence is a novelty while people have become accustomed to them at Jackson Park. The batteries are charged in a little boat house, fitted with slips under one of the bridges, to which current is supplied by an overhead circuit from the Lincoln Park lighting station. W. D. Ball, Chicago, superintended the installation here. Although no launches have yet been purchased for Garfield Park the matter has been under consideration, and the people of the West Side may yet have an opportunity to enjoy them in their favorite pleasure resort.

## Northwestern Electrical Association.

The fourth meeting of the Northwestern Electrical association was held at St. Paul on July 18th, 19th and 20th. There was a large attendance of central station men, and the leading electrical supply and manufacturing companies of the country were represented. During the sessions of the convention 30 applications for membership were received, which is ample evidence that the organization is appreciated throughout the Northwest and that it is destined to play an important part in the history of the electrical development of that section of the country. All the meetings were well attended, and in every instance the papers read were listened to with marked attention. During the convention the headquarters of the association were at the Ryan, and the management placed the ordinary at the disposal of the organization for the holding of meetings. In the halls approaching the place of meeting there were several carefully arranged exhibits of specialties, and an opportunity was afforded the representatives of supply houses to distribute circulars to the members. Altogether the convention was eminently successful, the meetings were well attended and were admirably conducted. At the conclusion of the business sessions the visitors were entertained by the electrical concerns of St. Paul and Minneappolis, and the social features, while not conflicting in any way with the regular order of business, made the meeting a thoroughly enjoyable affair.

The first business session was held on Wednesday morning and consisted chiefly in effecting organization and receiving reports from special and standing committees. President Page found it impossible to attend the opening session, which was presided over by Vice-president Baker.

At the afternoon session two important and interesting papers were presented. The first was by J. C. McMynn of Chicago on "Economy in the Boiler Room." Mr. McMynn found it impossible to be present at this meeting, but sent in his paper, which was read by Fred DeLand of Chicago. The discussion which followed the reading of this paper was participated in by several members. Mr. Rau gave an interesting description of the experience of the Edison company at Milwaukee, where internally fired boilers of the Edgemore Galloway type are employed. Mr. Stewart of Chicago expressed the opinion that while boilers of this kind were very efficient, it was difficult to clean the tubes, and this work required considerable time. He took occasion to pay a compliment to the plant of the Flour Exchange building, Minneapolis, where mechanical stokers were in use. Mr. Grover also took occasion to commend mechanical stokers. His personal experience, he said, convinced him that their introduction was an economical measure that could not be too highly valued. In his own plant a saving of 30 per cent. had been effected through their introduction. Mr. Debell of Sheboygan described several improvements that had recently been introduced in his station. Especially good results had been secured by introducing

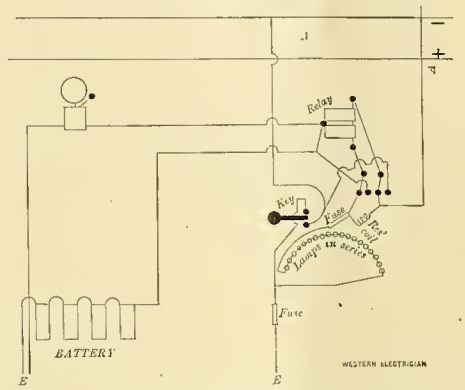



FIG. 3. ELECTRIC LAUNCHES IN CHICAGO PARKS.

a blower and utilizing slack coal instead of lump. He said his company was getting just as good results as when it used Hocking Valley coal. A point of especial interest in his estimation was an improvement by which the air drawn in by the blower was the hot air immediately above the drum of the boiler. This is passed in beneath the furnace at a temperature of nearly 200°. Mr. Markel of Chicago closed the discussion with a brief sketch of the development of boilers for central station work since the date of the first Edison installations. The improvements that had been made could only be appreciated by those who were familiar with the boilers used at that time. He believed there were still many improvements to be made, and he anticipated a considerable increase in efficiency in this important part of central station equipment.

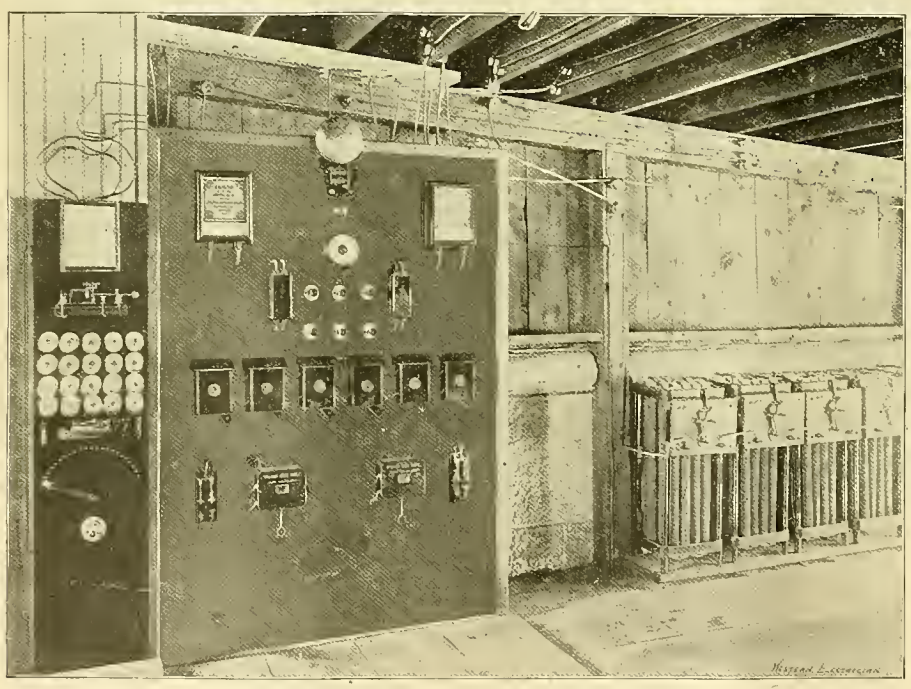


FIG. 2. ELECTRIC LAUNCHES IN CHICAGO PARKS.

The second paper of the session was read by Prof. George D. Shepardson of the University of Minnesota, Minneapolis. The title of this paper was "Relation of Technical Schools to Electrical Industries." It was received with marked attention, and at its conclusion Secretary Thom made a brief address, in which he commended the spirit and tone of the paper. An attempt to divert the discussion into a controversy over the merits of several "electrical schools" was unavailing.

The secretary announced the social features of the meeting, including several excursions, and read invitations extended by local companies, all of which were accepted.

The first business of importance transacted at the morning session on Thursday was the presentation of a report by the special committee appointed to consider the question of making the position of secretary a salaried office. This matter had been discussed at the meeting Wednesday afternoon. At that time a resolution was presented providing for suitable compensation. In support of this suggestion it was shown that nearly all the work of the association was transacted by the secretary, and as the importance of the organization increased the duties and demands on the time of that officer, it was pointed out, would grow proportionately. However, Mr. Thom, the present incumbent, announced that he would not accept a salary. He was willing, he said, to contribute his time as long as the association desired his services, and he considered himself amply repaid by the honor which the office conferred upon him. The association, however, was not willing to permit Mr. Thom to defray the expenses incident to his office and accordingly voted an appropriation of $75.

The committee on statistics, which had been engaged in collecting data relating to central station charges, was given further time to complete its work, and was authorized to publish 500 copies of its report as soon as the work of compilation was concluded.

The rest of the morning was occupied in the reading and discussion of B. J. Arnold's valuable paper on "Cost of Producing Electrical Energy," which is presented in another column. Mr. Markel of Chicago took exception to Mr. Arnold's statement that Mr. Crompton in his paper had assumed an ideal plant. It was Mr. Markel's belief that Mr. Crompton had based his statements upon figures collected from twenty central station plants. This view was not shared by other members. Mr. Arnold was complimented on all sides for his interesting contribution.

The last session of the convention occupied all of Thursday afternoon. In spite of the excessively hot weather the members remained in session from 2 o'clock until 6, when all the business of the meeting was finished. The first order of business was the reading of a paper on "Economical Operation of Electric Plants from an Electrical Standpoint," by C. K. Stearns of St. Paul. Several points in the paper were emphasized in the discussion in which Messrs. Stewart, Thom, Cunio and Grover participated.

Next in order was a paper on "Incandescent Lamps, Their Use and Abuse," by A. D. Page of Harrison, N. J. Several diagrams, illustrating the special points of interest in this paper were shown, and they proved an excellent feature. Mr. Stewart in discussing the paper laid particular stress upon the progress that has been made in developing the 220 volt lamp. Quite an interesting discussion over the question of the economical life of a lamp was engaged in by Messrs. Thorp, Kammeyer, Stewart and Howell.

"The Modern Dynamo" was the title of an interesting paper by Gilbert Donaldson of Minneapolis.

The last paper on the programme was read by Allan R. Foote of Washington, D. C. The title was "A Question of Public Policy," and the paper discussed the attitude of government toward corporations, with especial reference to the subject of acquiring control of what are now considered private enterprises. It was a reiteration of Mr. Foote's views on this subject and a compilation of authorities supporting his views. At the conclusion of the reading of this paper several members commended the attitude of Mr. Foote upon this important question, and it was decided to secure the publication of the paper in pamphlet form for distribution. The matter was referred to the secretary with power to act. A special vote of thanks was extended to Mr. Foote.

By unanimous vote the following named gentlemen were made honorary members of the association: Prof. George D. Shepardson, Minneapolis; B. J. Arnold, Chicago; A. D. Page, Harrison, N. J.; J. C. McMynn, Chicago; Gilbert Donaldson, Minneapolis; C. K. Stearns, St. Paul; Allan R. Foote, Washington, D. C.

The secretary announced that the next meeting of the association would be held at Milwaukee in January. At that time, he said, a business meeting pure and simple would be held. The mid-summer meeting, he explained, could not be expected to confine itself as strictly to business as the annual meeting, owing to the warm weather, yet he wished to compliment the members upon the strict attention they had given the sessions of the convention up to the very last moment. It showed the great interest that they felt in the proceedings and was highly complimentary to the gentlemen who had contributed to the success of the gathering by reading papers. On behalf of the organization he thanked the authors of those papers for their efforts in behalf of the association, which he assured them fully appreciated the labor and trouble required in the preparation and presentation of their papers. He extended a cordial invitation to all to attend the Milwaukee convention.

Numerous letters and telegrams were read from members who could not attend and from supply men who, though

not present, wished to be remembered by their more fortunate friends and competitors. The last order of business was the adoption of resolutions which are appended:

*Resolved*, That the thanks of this association be and they are hereby extended to the entertainment committee of the Twin Cities, to the Electric Engineering company of Minneapolis, the General Electric company and the Babcock & Wilcox company for the pleasant programme arranged by them for the association's enjoyment, also to the Twin City Rapid Transit company for courtesies extended to carry out that programme, and to Prof. G. D. Shepardson, John C. McMyan, B. J. Arnold, Charles H. Chalmers, A. D. Page, C. K. Stearns and Allen Ripley Foote for their able and interesting papers read at this convention, which make valuable additions to the literature of our association and profession.

The local committee on entertainment had prepared an excellent programme to occupy the time not devoted to the meetings of the association. The members were given an opportunity to visit the summer resorts in the vicinity of St. Paul frequented by residents of the Twin Cities. On Wednesday evening a trip to Lake Como was enjoyed by a large party. An excellent band concert, specially arranged for the occasion, was the feature of the evening. On Thursday evening an excursion to Lake Harriet was provided by the General Electric and Babcock & Wilcox companies. Here, also, excellent music was furnished by the Iowa state band. All day Friday was devoted to entertainment. At 9 o'clock in the morning the visitors assembled at the Ryan and under the direction of the committee were taken to the electric plants of the St. Paul Gas company and the Twin City Rapid Transit company. After inspecting these stations a trip up the river on the Flora Clark to Minnehaha was enjoyed. The next points visited were the Minneapolis power house of the street railway company and the lighting stations of the city. Between 4 o'clock and 5:30 the party was entertained at the University of Minnesota by Prof. Shepardson and much interest was manifested by the visitors in the electrical laboratory of that institution. At 5:30 o'clock the return trip was made in special cars provided by the Twin City Rapid Transit company. The trip was thoroughly enjoyed. The Electrical Engineering company of Minneapolis entertained the visitors, and an elaborate lunch was provided by that company during the trip up the river. The arrangements were thorough in every respect and the occasion was enjoyed by all.

### Convention Notes.

While the exhibits displayed at the convention were not on the elaborate scale that marked the meetings of the National Electric Light association or the American Street Railway association meetings, yet they were tastefully arranged and attracted considerable attention. The General Electric company and the Babcock & Wilcox company occupied an alcove at the head of the stairway leading to the convention hall. The General Electric company made a special feature of the new double filament incandescent lamp which it is just placing on the market. The company was represented by Messrs. Huey, Stearns, Gille and Howarth of the St. Paul office, Messrs. Page and Howell of the lamp works at Harrison, and A. C. Bunce, M. C. Wheaton and B. S. Terry of the Chicago office.

J. H. Finney of Minneapolis, represented the Fort Wayne company and the Columbia Incandescent Lamp company, and was untiring in his efforts to assist the visiting delegates in enjoying themselves.

Members of the Chicago delegation were found everywhere about headquarters, and they formed by far the largest representation of any city of the country. Among those who represented Chicago electrical houses were C. F. Gage, Washburn & Moen company; H. G. Lattimer, Central Electric company; S. T. Wells, Babcock & Wilcox company; L. W. Burch, Metropolitan Electric company; C. S. Cook, Westinghouse Electric & Manufacturing company; William Wilson, Electrical Appliance company; A. C. Bunce, General Electric company; Josiah Stedman, Page Belting company; Chas. E. Gregory, Chas. E. Gregory company; M. C. Wheaton and B. S. Terry, General Electric company.

The Electrical Engineering company, Minneapolis, made special arrangements for the entertainment of visitors. The company was represented at the convention by Morgan Brooks and F. J. Cram.

Representatives of the Central Electric, Metropolitan and Electric Appliance companies, Chicago, contributed to the entertainment and comfort of the delegates and explained their specialties.

An exhibit that attracted considerable attention was the collection of electrical heating apparatus shown by the Western Electric Heating company, whose offices are in the Endicot building, St. Paul. This company displayed polishing irons, sad irons, hat irons, goose irons, glue pots, radiators for house and office use, heaters and cooking utensils, including pots, kettles and ovens. Nicely finished curling irons and other special forms of apparatus were on exhibition. The company announces that it is in position to furnish any article displayed at the convention, and several managers of central stations examined the devices carefully, recognizing in their general adoption an excellent method of increasing the demand for current.

Among those in attendance at the convention were the following:

O. M. Rau, Thomas R. Mercein, and Herman Andrea, Milwaukee; F. F. Green, Wauwatosa, Wis.; P. Norcross and E. P. Norcross, Janesville, Wis.; E. L. Debell, Sheboygan, Wis.; W. B. Baker and Irving P. Lord, Waupaca, Wis.; E. Daniel, Menominee, Wis.; H. Armundson, La Crosse, Wis.; G. M. Newton, Sparta, Wis.; Charles Cunio, Oconomowoc, Wis.; H. C. Thom, Madison, Wis.; W. P. Fitch, Mason City, Ia.; H. O. Woodruff, Sioux City, Ia.; B. F. Miles and J. G. Pomeroy, Cleveland; Allan R. Foote, Washington, D. C.; R. E. Brown, Mankato, Minn.; John Bell, New York; A. D. Page and Wilson S. Howell, Harrison, N. J.; Robert W. Bruce, Prof. George B. Shepardson, Arthur S. Huey, Charles Wilson, Morgan Brooks, F. J. Cram, A. M. Robertson, Gilbert Donaldson, and J. H. Finney, Minneapolis; J. G. Robertson, O. Claussen, W. J. Bonwell, F. G. Bradbury, J. J. Schoenleber, S. B. Howarth, and C. K. Stearns, St. Paul; B. J. Arnold, C. E. Gregory, J. B. O'Hara, J. C. McMynn, Fred DeLand, A. C. Bunce, Josiah Steadman, M. C. Wheaton, C. Kammeyer, B. S. Terry, M. J. Sullivan, J. B. James, William Wilson, F. E. Donahue, W. W. Low, John R. Markel, S. G. Neiler, H. B. Morgan, Loren W. Burch, C. F. Gage, W. N. Stewart, S. T. Wells, C. S. Cook and H. G. Lattimer, Chicago.

## Incandescent Lamps; Their Use and Abuse.[1]

By A. D. Page.

In the present state of the art of incandescent lighting, in no way can central station managers increase the efficiency of their investment more than by careful study of ways and means of operating lamps in a manner which will insure an average maximum light for a minimum expenditure.

Too large a percentage of central stations judge the quality of lamps sold them almost entirely by their life, and even that poor basis of calculation is still further distorted by keeping no ampere records nor averaging results, but judging solely by the individual records of such lamps as may fail in the first hundred hours, or of those which live hundreds of hours past the point, at which, from an economical standpoint, they should have been broken. The importance to central station managers of judging lamps which are sold to them from some better basis than individual or even average life, can be better appreciated by referring to Fig. 1, showing curves of deterioration in candle power of lamps manufactured by different companies. In considering deterioration in candle power, it should be stated that it is a characteristic of every lamp which has yet been manufactured and should be considered entirely independent of blackening or discoloration of the bulb. Lamps may deteriorate to 50 per cent. of their initial candle power within two hundred hours and still show scarcely a trace of blackening. All lamps, the curves of which are shown, were purchased within six months in the open market in lots of from ten to twenty-five, and the curves are the average result obtained by starting each lamp at the particular voltage which would bring the lamp to exactly 3 watts per candle, maintaining the voltage constant throughout its life.

Curves Nos. 3, 5 and 6, Fig. 1, represent the best results obtained from the product of numerous foreign manufacturers. Nos. 4, 8, 9, 10, 11 and 12 each represent a different domestic manufacturer.

While there is no reason to suppose that the average life of lamps shown by Nos. 4 and 7 will be shorter than that of lamps represented by Nos. 10, 11 and 12, there is also no certainty that it will be longer, and if a lamp is to be branded as poor by the central station manager because of the breakage of a small percentage of lamps in the first one hundred hours, then the advantage is in favor of the lamp which reached 50 per cent. of its original candle power in the first two hundred hours, thus maintaining the carbon at a high degree of incandescence with the necessarily greater strain of the filament for only a few hours.

The carbon which maintains its candle power must continue to burn at a higher temperature, nearer the point of vaporizing, and is more likely to be destroyed by an abnormal increase in pressure than one which cools within the first few hours to a point where considerable increase in voltage is required to bring it to its initial degree of heat or incandescence.

From the standpoint of the central station, one of the worst guarantees that you could demand from the lamp manufacturer would be an individual life (for each lamp) of one or two hundred hours. The reason for such demand, when made on your part, arises from the erroneous impression that the lamp which lives only one to two hundred hours is necessarily defective. Nearly every lamp sold you, and particularly, those which show the best results, rises in candle power for the first few hours (this is not shown in Fig. 1, as in only one case was the first test after the lamps were started made before the candle power commenced to drop).

On nearly every central station, particularly on alternating current stations, during light load, the pressure on the primary is abnormally high. Add to this the difference between drop in the transformers and secondary wiring, as between full and light load, and the result which a test is quite certain to show, is pressure on the one or two lamps which the customer is burning during light load from 6 to 10 per cent. high.

Referring to Fig. 2, we find that burning a new 16 candle power 3½ watt lamp 7 per cent. high would, for the first few hours, raise its candle power to 25, and its efficiency to about 2.6 watts per candle. In less than one hundred and fifty hours, even maintaining the high pressure mentioned, the candle power and efficiency would fall below normal; but in the meantime, the new lamps which have been burned under the above conditions have been abused to an extent which would be quite certain to make the showing of some individual lamps very poor, through no fault of the lamps.

After lamps have been in use about two hundred hours, under average conditions, they could then be used where the pressure was high, without bringing the carbon to a dangerous degree of incandescence.

One of the best illustrations I can give of the importance of your judging lamps from some better standard than simply life, is to refer to an incident of which I had reliable information where a representative of the lamp company, which manufactured the lamps shown by Curve No. 12, Fig. 1, exhibited the valuable quality possessed by his lamp standing very high pressure. With a rheostat it was exhibited burning from normal to a very high candle power. He represented it as the toughest filament ever placed in a lamp, and I have no cause to disbelieve him.

If central stations run with a variation of from 6 to 20 per cent. in pressure they will find it necessary to demand tough lamps, the natural product of the amateur lamp manufacturer. To bring a product up, however, even from Curves Nos. 9, 10 and 11 to No. 4, means experience and thousands of dollars spent in experiments.

It also means that each one of over 50 different operations through which the parts of a lamp pass from start to finish, should receive careful, intelligent handling or direction. Perfection in any one particular will not attain even average results.

The manufacturer of lamps shown by Curve No. 4 might have furnished the same carbons to manufacturers of lamps represented by Curves Nos. 10 and 11, and the result which they would obtain would not differ materially from that secured with their own make of carbons. Curve No. 4, though it represents as high an average grade of lamp of any voltage above 100 as has yet been furnished to the customers of any lamp manufacturer, does not represent the highest point which will be attained.

Curves Nos. 1 and 2 represent experimental lamps manufactured and furnished for test by the same company, whose regular product is represented by Curve No. 4, and I am in-

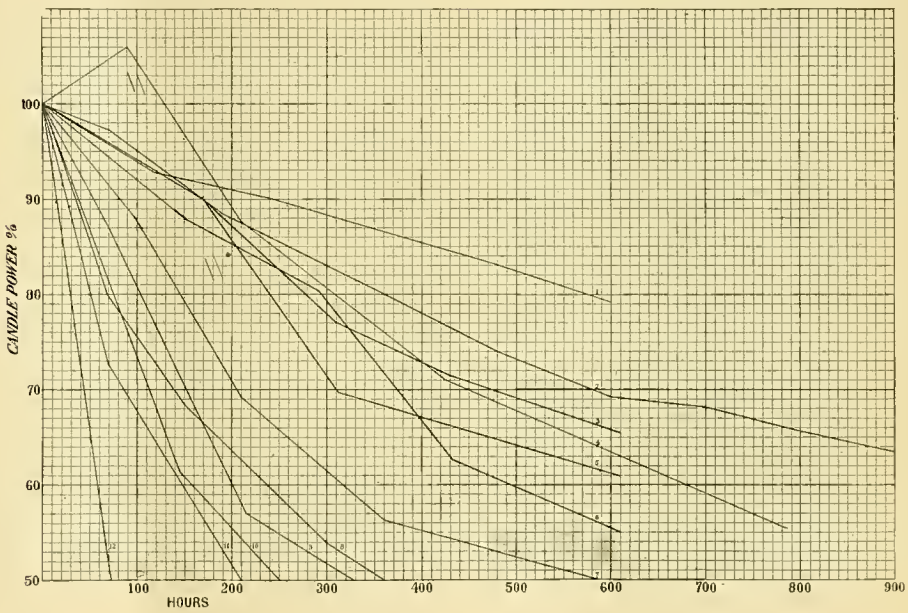



FIG. 1. INCANDESCENT LAMPS; THEIR USE AND ABUSE.

1. Read before the Northwestern Electrical association, St. Paul, July 19. 1894.

formed by reliable experts that within a few months the entire product of the company will be brought up to the standard represented by Curve No. 1.

That the relative value of the lamps represented by these curves may be fully appreciated, let us take the average candle power of Curve No. 1, Fig. 1, which for six hundred hours is 1,419 candles, and we find, to maintain the same average candle power, using other lamps, we should have to break lamps represented by Curve No. 4 at five hundred and thirty hours; No. 7 at one hundred and seventy hours; No. 8 at one hundred hours, No. 9 at one hundred and twenty hours, No. 10 at ninety hours, No. 11 at seventy-five hours and No. 12 at thirty-five hours.

All of the lamps represented by diagram No. 1 are of voltages from 100 to 125 volts, and though started at a higher economy than is commonly practiced by central stations (the 3.1 standard of Edison illuminating companies being the highest of which I have personal knowledge). Testing at 3 watts comes nearer to results obtained by commercial practice than a lower initial economy, as the tendency of the average central station is to run high.

Fig. 3 represents lamps of from 50 to 60 volts, started at 3 watts per candle, and tested under the same conditions as the 100 to 120 volt lamps. No. 1 is the product of the same factory as Nos. 1, 2 and 4, Fig. 1. No. 2 was manufactured by the same company as No. 9. No. 3 was manufactured by the same company as No. 11, and No. 4 was manufactured by the same company as No. 10.

As proven by these curves, and also, I believe, as generally acknowledged, it is much easier to produce a fairly good 50 volt lamp than one of a voltage above 100; but considering the progress which has been made within the last year in the high volt lamps I believe that in a short time a large percentage of alternating current central stations will find it to their advantage to use large transformers and secondary mains on the three-wire system, covering one or more blocks from one transformer or bank of transformers and using only lamps of over 100 volts, thus greatly economizing in copper and securing much better regulation than is now secured with numerous small transformers and 50 volts on the secondary.

The importance of good regulation or a constant voltage at the lamps is too little appreciated, the general opinion of central station managers apparently being that so long as the life of the lamp is satisfactory to themselves or their customers, if they increase the voltage either temporarily or permanently, the result would be to increase the average light. The facts are that burning lamps above their normal rating decreases the entire average candle power on the customers' circuits, and at the same time, if the station is on a meter basis, increasing the amount of the customers' bills. This statement is particularly true of lamps only of average quality.

Referring to Fig. 2, No. 5 represents a 108 volt, 16 candle power 3½ watt lamp burned at a constant voltage and reaching 11 candles at five hundred hours, starting the same lamp at 110 volts or at 17½ candles, 3.3 watts per candle, and inside of two hundred hours the candle power curve crosses the one burned at normal. Starting it at 112 volts or at 19½ candles, 3.1 watts per candle, in

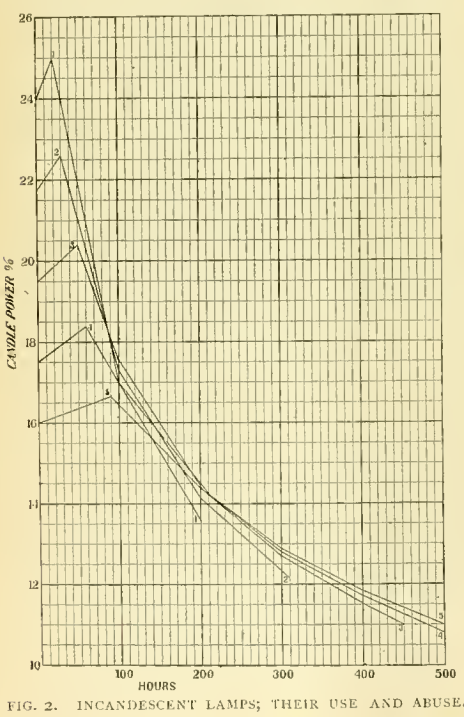



FIG. 2. INCANDESCENT LAMPS; THEIR USE AND ABUSE.

less than two hundred hours the candle power curve crosses both the others.

Curves Nos. 1 and 2 follow the same general law. The higher we raise the voltage the more rapid the drop in candle power, and when we consider that the lamp represented by curve No. 1 must be kept at 116 volts in order to give 14 candles of light after two hundred hours, and that should the voltage be brought back to normal or 108 volts, the candle power would be only about 9 candles, we can appreciate that on a station where the voltage varies even 7 per cent., the result must be a very uneven and poor quality of light, even though the life of the lamp is satisfactory.

The tendency of all central stations seems to have been to gradually raise their voltage with the intention of thus either burning out or increasing the candle power of the old lamps on their circuits. The result is only to either burn out an abnormal number of new lamps or bring them down to the candle power level of the old ones within two hundred hours.

The only practical method of keeping the average candle power of lamps on a station at a point which will be satisfactory to customers or on a competitive basis with other methods of lighting, is to keep records of the average life on the entire station where free renewals are furnished, and then to take out of the sockets and break up all lamps which are dim, by this means keeping down the average life to whatever constant is decided as the best under local conditions. Where lamps are sold to customers to keep the candle power of lamps in use on a circuit of a central station at a point which will insure satisfaction or tend to keep the electric light popular, is a difficult problem. Whether the customer is on a meter or on a contract basis, it is poor economy for him to keep lamps in his sockets which are giving only 50 per cent. of their initial candle power, but for the corporation which sold him the lamps and supply him with current, to call his attention to the fact that lamps in his sockets are giving only about 8 candles, and attempt to sell him lamps at 50 or 60 cents each, is not likely to bring about the desired result. To meet the above difficulties a number of central stations in different parts of the country are now selling lamps at retail to their customers at cost and a few stations even below cost, at the same time doing all in their power to prove to them

| | | 64 Watts | 56 Watts | 48 Watts | 40 Watts |
|---|---|---|---|---|---|
| 100 Hours | C P | 17 28 | 17 44 | 16 8 | 16 16 |
| | Average C P | 16 8 | 17 06 | 17 09 | 16 96 |
| | Average Watts Per Candle | 3 9 | 3 28 | 2 8 | 2 36 |
| | Candles Per Elec H P | 191 | 227 | 266 | 316 |
| 200 Hours | C P | 17 12 | 16 32 | 15 2 | 14 08 |
| | Average C P | 17 03 | 16 94 | 16 51 | 15 97 |
| | Average Watts Per Candle | 3 76 | 3 3 | 2 9 | 2 5 |
| | Candles Per Elec H P | 198 | 226 | 257 | 298 |
| 300 Hours | C P | 16 61 | 15 04 | 13 92 | 12 |
| | Average C P | 16 96 | 16 53 | 15 86 | 14 96 |
| | Average Watts Per Candle | 3 77 | 3 39 | 3 03 | 2 67 |
| | Candles Per Elec H P | 198 | 220 | 248 | 279 |
| 400 Hours | C P | 15 68 | 14 08 | 12 8 | 10 56 |
| | Average C P | 16 71 | 16 | 15 2 | 14 03 |
| | Average Watts Per Candle | 3 82 | 3 5 | 3 16 | 2 85 |
| | Candles Per Elec H P | 195 | 213 | 236 | 262 |
| 500 Hours | | 15 | 13 28 | 11 68 | 9 12 |
| | | 16 45 | 15 57 | 14 62 | 13 2 |
| | | 3 89 | 3 59 | 3 28 | 3 03 |
| | | 192 | 208 | 227 | 2 16 |
| 600 Hours | | 14 10 | 12 8 | 11 04 | 8 |
| | | 16 | 15 15 | 14 08 | 12 43 |
| | | 4 | 3 7 | 3 41 | 3 22 |
| | | 187 | 202 | 219 | 232 |
| 700 Hours | | 13 02 | 12 32 | 10 56 | |
| | | 15 84 | 14 78 | 13 63 | |
| | | 4 04 | 3 79 | 3 52 | |
| | | 185 | 197 | 212 | |
| 800 Hours | | 13 6 | 12 | 10 24 | |
| | | 15 6 | 14 45 | 13 23 | |
| | | 4 1 | 3 88 | 3 62 | |
| | | 182 | 192 | 206 | |
| 900 Hours | | 13 28 | 11 84 | 0 92 | |
| | | 15 36 | 14 18 | 12 88 | |
| | | 4 17 | 3 94 | 3 74 | |
| | | 170 | 189 | 200 | |

that only by a liberal use of lamps can they obtain the greatest amount of light for a given expenditure of money.

As the profit on the sale of lamps is decidedly a secondary matter as compared to the sale of current and the increased quality of the light, the above plan should commend itself to all central stations not on the basis of furnishing free renewals. It is also worthy of consideration that by adopting this plan the station controls what lamps shall be used on its circuit without dictating to its customers an important point while lamps show such widely different results as those shown by Fig. 1. And while customers, continue more likely to believe that the corporation is not supplying proper current, than to believe that the quality of lamps they have been purchasing is at fault.

Another method of inducing customers to destroy dim lamps which has found favor with a number of stations, is to make a price for lamps of say 40 cents each and agreeing with their customers to exchange all dim lamps, which they have sold them, at half price, that is, for every dim lamp which the customer returns before the carbon is burned out, he receives a new lamp for 20 cents.

Within the last few months the question has often been asked me by central station managers, "What economy of lamps should we use?" This question should, I believe, be settled by central station managers themselves on presentation of facts, they having control of the regulation of their station and knowledge of local conditions.

Fig. 4 shows the same quality of lamp manufacture as curve No. 2, Fig. 1, and represents 16 candle power lamps started at an initial economy of 4, 3½, 3 and 2½ watts per candle. The accompanying table shows candle power, average candle power, average economy and average candles per electrical horse power at one hundred hour periods in their life.

In considering these curves and table it should be remembered that the result would have been much less favorable to the higher economy lamps had the test been made and the curves plotted with a poorer quality of lamp, and also that satisfactory results with lamps of higher economy than 3½ watts per candle can only be obtained by exercising the greatest care in maintaining a constant voltage at the lamps. Referring to the table briefly, it will be found that even at six hundred hours, lamps of the highest initial economy show the best average result as to average watts per candle and average candles per horse power. And that at nine hundred hours 3 watt lamps show better average results than lamps of 3.6 or 4 watts. The greatest objection which can be urged against the high economy lamp is that while at nine hundred hours the 4 watt lamp reaches a minimum candle power of 13¼ candles and the 3½ watt lamp about 12 candles, the 3 watt lamp reaches 10 candles and the 2½ watt lamp at six hundred hours reaches 8 candles. At the present price of lamps, where fuel is high and the customers' bills are made up on the basis of lamp hours, it would, without question, pay the station to use high economy lamps, breaking them at a point which would insure satisfaction as to average light and keeping the average life comparatively short.

Whatever economy or make of lamp you decide to use, by no means can you so greatly increase the efficiency of your station as by making every possible effort in the direc-

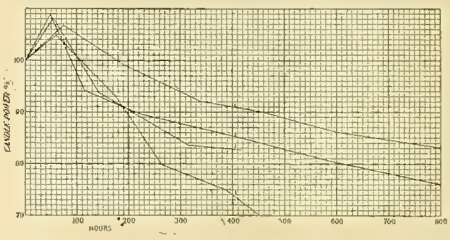



FIG. 3. INCANDESCENT LAMPS; THEIR USE AND ABUSE.

tion of maintaining a constant voltage at the lamps. This can only be accomplished and maintained by constant use of reliable, portable instruments. No switchboard instrument should be relied on, without often checking it by some reliable standard, and it should also be borne in mind that, owing to the varying drop at various loads, constant voltage at the station is just what is not wanted. If you do not possess a reliable, portable volt-meter, such an instrument should be your next purchase. Then by constant use on your circuits at different loads and profiting by the knowledge thus obtained, you would soon find a marked improvement in your lighting and would be in a position to judge which make and what economy of lamp is the best for you to purchase.

## Alexander Siemens.

The completion of the laying of the last Atlantic cable for the Commercial Cable company, furnished by Siemens Brothers & Co., London, by the Faraday was announced in the WESTERN ELECTRICIAN of July 14, 1894. The chief of this firm, Alexander Siemens, was on board, personally superintending the laying of the cable, and soon after the successful termination of the work of again connecting the old world and the new, he visited Chicago. Mr. Siemens, who is pleasantly remembered in this country as one of the official delegates from England to the World's Electrical congress, held last summer at Chicago in connection with the World's Fair, and who is the successor in Siemens Bros. & Co. to the late Sir William Siemens, was accompanied by Arnold von Siemens, one of the chiefs of the Berlin firm, son of the late Dr. Werner von Siemens and brother of William von Siemens and Count von Schlippenbach, a major in the German army and a friend of the Siemens family. The party while in Chicago was entertained by O. W. Meysenburg, president of the Siemens & Halske Electric company of America, in his beautiful residence at 141 Astor street. A reception and musicale, Thursday evening, July 19th, was one of the pleasant social events given in honor of the distinguished guests. Herr von Siemens, son-in-law of Prof. von Helmholtz, whose serious illness has been announced, has received word that that eminent scientist is somewhat improved, and that although suffering from a stroke of paralysis in the left side, his organs of speech were at no time affected.

Alexander Siemens, who is at the present time president of the English Institution of Electrical Engineers, in talking to a representative of this journal, spoke very enthusiastically of the new cable and the success his house had in laying it. As a matter of fact, the Faraday broke all previous records in cable laying on its recent trip, the actual time engaged in the operations being only 20 days. It was necessary during the voyage to grapple for portions of the cable upon several occasions, and bad weather was encountered, especially off the banks of New Foundland, where the habitual fog was thick and prevented the buoyed shore end of the cable from being discovered for some time, but not a hitch marred the excellence of the work. This cable, Mr. Siemens asserts, is the finest now lying at the bottom of the ocean, and is guaranteed to exceed in capacity by one-third the Commercial company's two cables laid in 1884. The tests upon the new cable were of the most severe character and an alternating current at 5,000 volts pressure was employed to discover any existing flaws or defective qualities.

In view of some of the criticisms upon the paper read by W. H. Preece on "Ocean Telephony" before the World's Electrical congress, in which the author argued the possibility of speaking across the ocean and of accelerating the rate of telegraphic messages to a considerable extent, the judgment of so eminent an authority as Mr. Siemens upon such matters, the excellence of whose work upon ocean cables has been so markedly valuable, should bear great weight. Mr. Siemens expressed the opinion that there could be no doubt of the possibility of such an undertaking as building a cable for telephonic communication under the At-

lantic. and that Mr. Preece in his researches arrived at correct conclusions, but that it would be difficult, in fact impracticable, to lay and operate such a cable with commercial success.

Mr. Siemens, judging from the expressions of opinion drawn from him in answer to inquiry, evidently views electrical practice in the United States and Canada very much in the same light as do other noted electricians from the other side who have complained of some of the faults here. He called particular attention to the speed of the trolley cars and declared that he was startled by the reckless manner in which many of them appeared to be handled. When it is desired to construct an electric road in England a special act of Parliament must first be secured, and it would seem

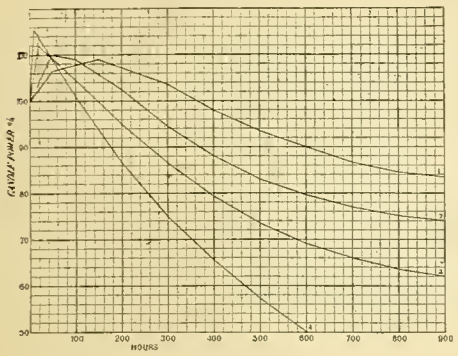



FIG. 4. INCANDESCENT LAMPS; THEIR USE AND ABUSE.

that the introduction of the overhead trolley there was being discouraged as much as possible. Mr. Siemens in his several visits to this country has not failed to notice the lack of severe regulations regarding wiring and installation work, and called attention to the rigid rules of the English Board of Trade in relation to the subject. Niagara Falls and the work being done there, he said, of course are being carefully watched by foreign electrical engineers, but there are a great many who are not inclined to indorse the adoption of the alternating current system, but who prefer rather to favor a high tension direct current system for general power transmission purposes. When reference was made to the paper read upon the subject before the Institution of Electrical Engineers by Prof. Forbes, and an intimation expressed that the criticisms made upon it in the discussion which followed were very severe, Mr. Siemens smiled and admitted that the theories of Prof. Forbes might have been treated with more tenderness. Mr. Siemens is watching with much interest the progress being made in laying the new Anglo-American cable upon which the Britannia and Scotia are now engaged, for it has been announced that it will exceed in capacity the latest cable of the Commercial Cable company by 90 per cent. "We will wait and see," he remarked. "It is not wise to prophesy in regard to the accomplishments of enterprises in which electricity plays such a factor, but we will wait and see if it is so that the Anglo- American cable is nearly twice as good a cable as ours is." Mr. Siemens is an affable and courteous gentleman and he has made many warm friends during his visits upon this side of the water. He and his party will sail from New York, where he has been for several days upon business, Saturday, July 28th, upon the German ship, the Aller.

## Death of Edmond Julien.

Edmond Julien, the distinguished engineer and founder of what is known in this country and Europe as the Julien system, expired at his home in Brussels on the 5th of this month. Mr. Julien was born at Andenne, on August 31, 1838. He was by profession a civil engineer, and in that capacity built a number of railroads in Russia and Spain. He had the reputation of being of the first rank as a railroad engineer. He amassed considerable wealth in railroad building, and embarked almost all of it in the storage battery business in connection with Faure and Phillipart. He built what was probably the first storage battery factory in Europe, at Brussels; and in 1885 his storage battery car took the first prize in mechanical traction at the Antwerp Exposition. Mr. Julien was very highly esteemed by his fellow citizens at Brussels; and King Leopold knighted him in 1889. He was a man of most imposing appearance, being nearly six feet four inches in height, and of splendid proportions. He leaves a charming family and a beautiful home is Brussels, where hospitality was dispensed with a lavish hand.

## Cost of Producing Electrical Energy.[1]

By B. J. Arnold.

It was my intention when asked to prepare a paper upon this subject, to be read before this convention, to point out some of the principal sources of loss in the operation of the present central station, and afterward to assume an ideal plant, designed in accordance with the latest practice, and show at what price per kilowatt hour the average station could deliver electrical energy to the consumer.

After the paper was partially prepared on this basis, R. E. Crompton read before the Institution of Electrical Engineers of London a paper covering practically this ground, in which he shows that with coal having a calorific value of 14,500 B. T. units, and with boilers capable of evaporating 12 pounds of water at a pressure of 150 pounds, and the losses so proportioned that 2½ pounds of this coal will evaporate 25 pounds of water, that a kilowatt hour can be produced for 3 cents and delivered to the customer for 6 cents leaving a profit of 3 cents over and above all operating expenses and interest on the investment. He figures that an average of 20 pounds of steam per kilowatt hour is all that would be required for actual service.

Mr. Crompton's paper having covered practically the ground I had mapped out, has lead me to abandon my original plan, in place of which I will present to you to-day the records of a number of central stations operating in this country and Europe, from which you can, by comparison, ascertain whether your stations are doing as good service as they should. I will endeavor also to suggest ways in which the earning capacity of stations now running can be increased.

The losses between indicated and electrical horse power in a fairly well designed high speed, belted, direct current station are about as follows: Engines 10 per cent., belts 4 per cent., dynamos 10 per cent., line 10 per cent., making a total commercial efficiency of 70 per cent.

In alternating directly belted plants the losses on engines, belts and dynamos are practically the same as given above. The losses in the primary circuit are usually 5 per cent. Where there are many small transformers and when working under loaded, as they usually are for a large portion of the time in small central stations, the average loss will be about 10 per cent., although when they are working at their rated load they will give an efficiency of 93 per cent. to 95 per cent. The loss on the secondary wiring is usually 2 per cent. Combining these losses we find the average commercial efficiency of the alternating plant to be 65 per cent. In stations operating large engines belted to a countershaft the losses are practically the same as given above, except that the loss between the power delivered by the engine and the power delivered to the generators, is usually about 20 per cent., making the commercial or industrial efficiency of the

[Continued on page 43.]

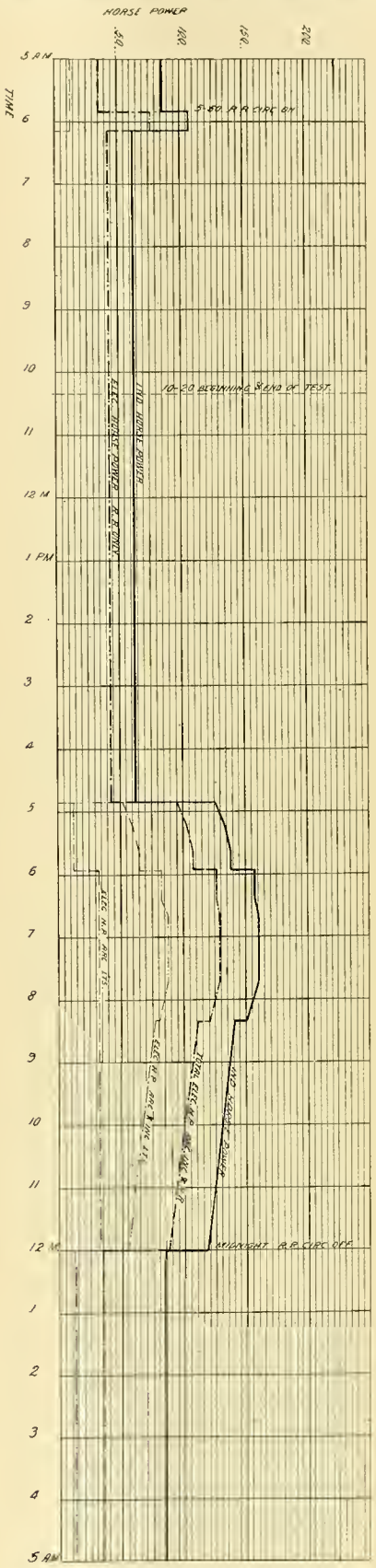



FIG. 1. COST OF PRODUCING ELECTRICAL ENERGY.

TABLE NO. I.

| | Direct Current. | | Direct Current with Accumulators | | | Alternating |
|---|---|---|---|---|---|---|
| | Elberfeld. | Hamburg. | Barmen. | Hanover. | Dusseldorf | Cologne. |
| GENERAL DATA. | | | | | | |
| Fifty watt lamps capable of being supplied from the works | 10,000. | 11,600. | 4,500. | 12,000. | 12,000. | 13,600. |
| " " " " " " " " mains | 12,000. | 12,000. | 6,500. | 23,000. | 23 000. | 24 000. |
| Available power in kilowatts | 500. | 580 | 225. | 600. | 600. | 680. |
| EXPENSES OF FIRST ESTABLISHMENT. | | | | | | |
| Installation capital, in dollars | 272,829.96 | 473,912.90 | 204,425.53 | 504,176 51 | 557,194.58 | 472,500.58 |
| Specific expenditure, in dollars per kilowatt | 545.53 | 816.93 | 908.50 | 785 70 | 926.35 | 693.55 |
| " " " " lamp | 24.25 | 31 43 | 31 53 | 39 28 | 46.32 | 34.68 |
| RECEIPTS AND EXPENSES. | | | | | | |
| Duration of working, in years | 5. | 4. | 5. | 2. | 1. | 1. |
| Total receipts, in dollars | 46,281.80 | 112,245.49 | 23,995 08 | 65 002.22 | 54.710.04 | 54 738.65 |
| Receipts, per cent. of the capital | 20.5 | 23.68 | 11.74 | 15 8 | 9.8 | 11 5 |
| Total expenditure, in dollars | 17,498.09 | 26,568.21 | 8,365 67 | 18 370.92 | 15,328.13 | 20,460.21 |
| Expenditure, per cent. of the capital | 6.41 | 5.62 | 4 9 | 4 46 | 2.72 | 4.07 |
| Rough total profits, in dollars | 28,782.81 | 85,677.28 | 15,629 43 | 46,621 30 | 39 381.91 | 34,278.44 |
| Profits, per cent. of the capital | 14.09 | 18.05 | 7 65 | 11.34 | 7 | 7 2 |
| EXPENSES—COST. | | | | | | |
| Total energy in kilowatt hours, produced | 313,438. | 542,900. | 114,996. | 452 520. | 484.111. | |
| " " " " distributed | 305,794. | 513,183. | 122,026 | 365,114. | 337,285. | 397,074. |
| Efficiency of the mains, per cent | 97.5 | 94.5 | 84.16 | 80.69 | 69.68 | |
| Energy in watt hours per lb. coal, produced | | 148. | 104. | 219. | 185. | |
| " " " " " distributed | | 140. | 90. | 181. | 129. | 71. |
| Salaries in cents, per kilowatt hour, produced | 2.44 | 1.80 | 3 28 | 1.73 | 1 63 | |
| " " " " " distributed | 2.52 | 1.92 | 3 90 | 2 15 | 2 33 | 2 93 |
| Cost per kilowatt hour in cents, produced | 5.57 | 4.91 | 5 76 | 4 05 | 3.15 | |
| " " " " distributed | 5.70 | 5.18 | 6.85 | 5 02 | 4 54 | 6.65 |
| Mean selling price in cents per kilowatt hour, including all expenses | 18.29 | 21.86 | 19 65 | 17.79 | 16.20 | 17.81 |
| Charge without deduction for the kilowatt hour, in cents | 17.65 | | 17.65 | 17.90 | 20.95 | 15 96 |
| Price for cubic feet of gas, consumption above 3,000 cubic feet, cents | .11 | | .12 | .105 | .103 | .081 |
| CO-EFFICIENTS OF UTILIZATON—DURATION OF LIGHTING. | | | | | | |
| Number of 50 watt lamps installed | 11,100. | 14,000. | 7,395. | 13,642. | 16,623. | 15,329. |
| Maximum power utilized in kilowatts | 400. | 462. | 139. | 415. | 309. | 325. |
| Ratio of power utilized to power available | 0.80 | 0.79 | 0.61 | 0 48 | 0 51 | 0.50 |
| Duration of lighting, in hours, per annum | 569. | 693. | 325. | 529. | 419. | 422. |
| EMPLOYMENT OF ACCUMULATORS. | | | | | | |
| Energy expended for the charge, in kilowatt hours | | | 59,573. | 194,733. | 279,506 | |
| Energy furnished by the discharge, in kilowatt hours | | | 42,584. | 154,836. | 210,561. | |
| Industrial efficiency of the accumulators, per cent | | | 71 5 | 79 4 | 77.5 | |
| Ratio of energy supplied by the accumulators to the total energy distributed, per cent | | | 35. | 42.3 | 62. | |
| Loss in the accumulators, per cent. of the total energy distributed | | | 14. | 11. | 13. | |

1 Read before the Northwestern Electrical association, St. Paul, July 19, 1894.

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CABLE dispatches from Berlin last week announced the serious illness of Prof. von Helmholtz, but later advices give hope for the recovery of the distinguished scientist. During his visit to this country last summer the charming modesty and simplicity of his manner won admiration from all. Those who were in attendance at the Congress of Electricians particularly had an excellent opportunity of observing these traits. The complete and speedy recovery of the noted scientist is earnestly looked forward to by his many friends on this side of the water.

IT is evident that the new rapid transit commissioners of New York anticipate the adoption of their plans by the people when the matter is submitted to the voters in November, as they are perfecting their plans and hope to be in readiness to commence operations immediately after the verdict of the people is announced. The chief engineer of the board has been instructed to visit London and Paris for the purpose of studying the underground systems in operation in those citiest and it is probable that many features adopted in those places will be introduced in New York. There seems to be a unanimity of opinion that the city will be obliged to lend its credit to the enterprise.

THE street railway interests of Milwaukee seem to conflict with the plans of certain city officials. At the present time there is prospect of a long legal fight between the city and the company over the paving of streets on which there are tracks. The Board of Public Works has notified the company to put in a bed of concrete under its rails and use a grooved rail on those streets. Manager Wyman last week refused to comply with these instructions, and it is announced that a legal battle will be commenced to compel the company to do so.

Another controversy is in progress over the taxation of the company's franchises. The city assessor has estimated the rights, privileges, franchises, tracks, poles and wires of the Milwaukee Street Railway company as being worth $1,800,000, and made return for taxation on that valuation. The company appealed to the Board of Review, claiming the valuation was exorbitant, unjust, illegal and contrary to public policy, and that it would result in the hopeless bankrupting of the corporation or else the cutting off of all transfer privileges to passengers and the abandonment of many miles of "feeder" lines now operated at a loss.

Electric lighting companies as well as the street railway companies of the state are watching this controversy closely, as it is believed that success in this case will be followed immediately by like assessments upon the property of all lighting and street railway companies of the state.

THE blockading of mail trains in California by strikers has had the effect of swelling the volume of telegraph business in San Francisco to an extent never known before in that city. So great has been the increase since the beginning of the trouble that both the Western Union and Postal companies have been compelled to increase their working forces to the greatest capacity of their offices. Many of the eastern cities have had a similar experience. Such a crisis presents an admirable opportunity to comment upon the telegraphic facilities of the country. Had the telegraph lines been destroyed, communication between the large cities would have almost ceased for a time and immense loss would have been entailed. It is the general reliability of the telegraph service which makes it possible for the government troops to be assembled upon short notice and which is responsible in some degree for the policy of keeping the army as small as possible. Considering the vast volume of business handled by the telegraph companies during the labor troubles the service has been very satisfactory and a credit to the companies.

AN electric street railway war is being waged in Savannah, Ga., and the public is enjoying the privileges of extraordinary service and absurdly low rates of fare. A new company, by paralleling the lines of an existing road, made business unprofitable for both concerns, and a rate war ensued which, if continued, must ultimately result in the financial ruin of one line or both. On short trips the fare has been made one cent, and on long trips three cents. The president of one company threatens to make all fares one cent. A contest of this kind is seldom attended with desirable results, and it is to be regretted that the spirit of competition should induce capitalists to parallel the tracks of an electric road by another similar line while there is still so much unoccupied territory. In the case in question the older company announces that it will maintain the fight until one company or the other is forced to cease operations. Competition is always lawful and usually commendable, but to overstock a city with rival electric lines is an unwise policy, and one which will result eventually to the disadvantage of the patrons as well as the owners.

WRITING for *Cassier's Magazine*, Arthur V. Abbott of the Chicago Telephone company, says that there are now in operation in the United States more than half a million miles of telephone line, bringing into speaking relations over 250,000 telephonic subscribers, and employing in daily service over 600,000 telephones, by means of which 600,000,000 messages are transmitted annually. These figures are undoubtedly as authentic as it is possible to obtain and they express comprehensively the wonderful service of the telephone in daily business life. When it is taken into consideration that this development took place while the industry was wholly in the hands of the Bell Telephone company, and that instruments are now to be obtained for much lower figures than was possible heretofore and from a number of companies, it is to be presumed that the future growth and popularity of the telephone will be in a still greater ratio. Recent developments portend a great field for long distance lines, and the splendid service of these lines during the storms of last winter, when the telegraph lines were rendered practically inoperative for a time, attracted public attention forcibly to this field and proved that dependence could be placed upon the telephone in this application.

MANAGERS of central stations, who in their eagerness to get new business are willing to offer special inducements such as the wiring of buildings free of cost, should take a lesson from an eastern lighting company which to-day finds itself in a peculiar position. This corporation a couple of years ago absorbed several smaller companies operating in the same town, among them an Edison plant, from which current was furnished to the city building under contract. The Edison company had wired the city building to get the contract, and, as its managers thought, to be more secure in having the contract renewed at its expiration. The work was done several years ago, and the material cost over $1,000. To-day the present owner of the plant is unable to secure a renewal of the contract, and the city refuses to buy the wire in the building on the ground that the work would not be accepted to-day as a first-class job, whatever it might have been considered at the time the building was first wired. This experience should prove a warning to others. It is true that the practice of wiring buildings free of cost has been discouraged of late years, and to-day there is comparatively little of this done, yet in some places it is still done by new companies desiring to gain a foothold. It is a pernicious practice and should be discouraged until it is discontinued altogether.

CONSIDERABLE space is devoted in this issue to the proceedings of the summer meeting of the Northwestern Electrical association at St. Paul last week. The convention was a successful gathering, the attendance was large and the interest in the business under consideration was sustained throughout. The papers contributed treated of timely topics; they were carefully prepared and ably presented. There were some valuable statistics presented, the data furnished in Mr. Arnold's paper especially being of great importance. It will be noticed, too, that Mr. Arnold calls attention to a point repeatedly emphasized in these columns—the desirability of utilizing storage batteries as an auxiliary in central station work. Mr. McMynn's paper contains many practical suggestions and should receive attention. There were also papers by Prof. Shepardson, Mr. Stearns and Mr. Donaldson which provoked considerable discussion. Mr. Foote's paper on "A Question of Public Policy" excited considerable interest. Mr. Page's suggestions on the subject of incandescent lamps are considered more in detail elsewhere.

It was announced before the close of the convention that advances had been made by older associations with a view of absorbing the Northwestern, but the propositions were not considered with favor. The members believe that there is a good field in the West for a first-class electrical organization, and they feel that it is to their interest to continue under their present policy rather than as a part of a larger association. It was also announced that at the January meeting of the association there would be a more extended programme than that presented at St. Paul. All things considered, the convention last week reflected credit upon all who participated, and Secretary Thom is deserving of special commendation.

MANAGERS of incandescent lighting stations will find Mr. Page's paper on "Incandescent Lamps, Their Use and Abuse," a valuable contribution to the literature of this subject. The author says that central station managers should realize the necessity of studying the ways and means of operating lamps so as to insure an average maximum light at a minimum expenditure, and that some better basis of judging the relative merits of lamps should be established than the individual or even the average life. Too large a percentage of central stations, he says, judge the quality of lamps almost entirely by their life, and even that poor basis of calculation is still further distorted by keeping no ampere records and not averaging results, but judging solely by the individual records of such lamps as may fail in the first hundred hours, or of those which live hundreds of hours past the point at which, from an economical standpoint, they should have been broken. An essential feature in securing good results is good regulation or a constant voltage at the lamps. There seems to be an opinion among station managers that so long as the life of the lamp is satisfactory to themselves or their customers an increase in the voltage either temporarily or permanently would increase the average light, whereas in reality burning lamps above the normal rating decreases the entire average candle power on the customers' circuits and at the same time, if the station is on a meter basis, increases the amount of the customers' bills. It will be seen that such a condition of affairs will soon prove to be unsatisfactory to all concerned. Mr. Page thinks that the only practical method of keeping the average candle power of lamps on a station at a point which will be satisfactory to customers or on a competitive basis with other methods of lighting, is to keep records of the average life on the entire station where free renewals are furnished, and then to take out of the sockets and break up all lamps which are dim, by this means keeping down the average life to whatever constant is decided as the best under local conditions. More difficulty is experienced in keeping the candle power of lamps at a point which will insure satisfaction and tend to popularize electric lighting, where customers are obliged to buy their lamps. In order to overcome the objections which naturally arise under this arrangement some central stations are selling lamps at an actual loss while many are furnishing them at cost. The wisdom of this policy will be recognized by every experienced central station manager. There are many advantages to be gained, not the least of which is that it gives the management the selection of the lamps to be used on its circuits.

## Cost of Producing Electrical Energy.

[*Continued from page 41.*]

above systems 58 per cent. and 52 per cent. respectively, although there are many cases on record in which the losses are far greater than these, caused by unsoldered joints in the line construction, or defectively designed and operated machinery.

Table No. 1, published recently in L'Industrie Electrique, was prepared by J. Laffargue. I have reproduced it here, as it contains the most complete information regarding foreign central stations that I have been able to secure. The stations are all located in Germany: two of them, those at Elberfeld and Hamburg, being direct current plants, the one at Cologne an alternating station, and those at Barmen, Hamburg and Dusseldorf direct current stations with accumulators as auxiliaries. The table enables us to compare the relative merits of the three systems, and as will be noticed, the alternating station at Cologne produces 71 watt hours per pound of coal, and delivers a kilowatt to the customer for 6.65 cents. The station at Hanover produces the greatest number of watts per pound of coal, namely, 219, and delivers a kilowatt hour to the consumer for 5.2 cents, while the best result of all is shown by the station at Dusseldorf, producing, as it does, 185 watt hours per pound of coal and furnishing a kilowatt to the consumer for 4.54 cents. This would seem to indicate that there is an advantage in using accumulators.

It is also interesting to note that the average commercial efficiency of the accumulators is 76.1 per cent.

Mr. Laffargue adds that the following percentages are allowed for depreciation: 1½ to 2 per cent. on the buildings; 4 to 5 per cent. on the boilers and engines; and 6 per cent. on the accumulators; 3 per cent. on the mains, and 8 to 10 per cent. on the various auxiliaries of the plant. These figures are about correct for practice in this country, except on the accumulator question, and as there are now numerous strong companies entering the field in this country, who are willing to guarantee to maintain battery plants for 10 per cent. per annum, it is possible that we can soon reach the state of perfection in the line that is indicated by these figures.

In comparing the figures on a basis of cost per kilowatt hour delivered to the consumer, the loss in the mains at the various stations should be taken into consideration, as it will be noticed that at Dusseldorf the loss between the station and the consumer is over 30 per cent., at Hanover 20 per cent., Barmen 15 per cent., while at Hamburg and Elberfeld it is but 5½ per cent. and 2½ per cent. respectively. Were these allowances made, it would probably bring the cost at Dusseldorf much below the present figure, but not knowing the exact conditions it was impossible to make the proper allowance in this paper.

The first part of table No. 2 marked "Direct Current," was prepared from reliable information on file in the writer's office, and is the result of the operation of fifteen large direct current stations located in different parts of the United States. The three succeeding parts of the table marked "Direct Current," "Alternating Current" and "Combined Systems," have been compiled from information secured from the report of the committee on statistics of the National Electric Light Association, presented at its last meeting, and figures were chosen only from such stations as seemed to bear evidence of careful compilation. This report did not give the cost of coal per ton, nor the cost of coal per kilowatt hour, but simply gave the watt hours produced per pound of coal. By assuming a price per ton on the coal we have deduced the costs per kilowatt hour which are given, but not having the information necessary to ascertain the operating expenses or fixed charges, the total cost per kilowatt hour delivered to the consumer is omitted.

In general, however, I will state that the expense of operating in central lighting stations, is approximately as follows:

| | |
|---|---|
| Fuel | 23.15 per cent. |
| Labor | 21.20 " |
| Lamps | 7.75 " |
| Repairs | 13.10 " |
| General expenses | 23.15 " |
| Other expenses | 11.65 " |
| Total | 100.00 " |

The last portion of table No. 2 is a synopsis of table No. 1. Table No. 3 is the result of three tests made under the direction of the writer on a combined electric and lighting station, to ascertain the relative economy on oil and coal for fuel. Inasmuch as the information is quite complete it has been thought advisable to insert it in this paper. The station consists of two compound condensing engines, coupled directly to a line shaft. This shaft runs two 90 kilowatt railway generators, two 16 kilowatt arc light machines, two alternating incandescent dynamos of 30 and 50 kilowatt capacity respectively, or a total capacity of 392 kilowats. The station is delivering but 1,248 kilowatt hours, showing that it is running considerably under loaded.

Figure No. 1 is a diagrammatic representation of the load during the 24 hours' run. The spaces between the vertical lines represent time and the horizontal lines horse power. The upper heavy line represents the total indicated horse power in the cylinders of the engine. The dotted line immediately below this represents the total electrical horse power delivered on the switchboard. The difference between these two lines represents the power lost in overcoming friction of engine, line shafting and the electrical losses in the dynamos. The third dotted line from the top represents the electrical horse power required by the arc and incandescent lights, and the lower dotted line represents the electrical horse power required by the arc lights alone.

Referring to table No. 3 it will be observed that the test began at 10:20 A. M. and continued for 24 hours. As the load in this station varied greatly, one of the objects of the test was to ascertain the cost of producing power during the different periods, and the right hand column in the table shows the total cost per kilowatt hour of the power thus produced.

The railway portion of this station operates from four to six cars, and during the time of the test but four cars were in operation. The cars started at 5:50 A. M. and ran until 12 o'clock midnight, and the lighting load was added as indicated by the figure.

TABLE NO. 2.

| | STATION | H.P. CAPACITY | KILOWATT CAPACITY | HOURS OPERAT PR DAY | WATT HRS PER DAY | COAL KIND USED | COST COAL PR TON | WAT HRS PER LB COAL | COST COAL PR K.W. HR | COST OTHER EXPS K.W. HR | TOTAL COST PR K.W. HR DELD TO CONSMR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DIRECT CURRENT | 1 | | | | 604,600 | | $2.53 | 114 | cents 111 | cents 4.44 | cents 6.05 |
| | 2 | | | | 404,300 | | 3.01 | 88 | 1.10 | 4.06 | 5.76 |
| | 3 | | | | 395,300 | | 2.57 | 107 | 1.20 | 5.16 | 6.36 |
| | 4 | | | | 289,600 | | 2.47 | 122 | 1.01 | 4.72 | 5.73 |
| | 5 | | | | 194,150 | | | | | | 6.35 |
| | 6 | | | | 140,000 | | 2.55 | 108. | 1.18 | 5.76 | 6.94 |
| | 7. | | | | 126,700 | | 3.15 | 53 | 2.96 | 5.92 | 8.88 |
| | 8 | | | | 135,700 | | 1.34 | 71. | 1.36 | 3.37 | 4.73 |
| | 9 | | | | 85,100 | | 1.42 | 65 | 1.10 | 3.61 | 4.71 |
| | 10 | | | | 53,700 | | 2.20 | 53 | 2.24 | 3.05 | 5.11 |
| | 11 | | | | 50,320 | | 82 | 48 | .85 | 5.07 | 5.92 |
| | 12 | | | | 47,800 | | | | 2.24 | 4.69 | 6.93 |
| | 13 | | | | 37,100 | | 2.26 | 82 | 1.38 | 5.71 | 7.09 |
| | 14 | | | | 33,600 | | 2.38 | 66 | 1.80 | 4.42 | 6.22 |
| | 15 | | | | 33,400 | | | | .11 | | 6.19 |
| | AVERAGES | | | | | | 2.28 | 81.5 | 1.46 | 4.65 | 6.20 |
| DIRECT CURRENT | 16 | 90 | 67.045 | 24 | 1,609,070 | bitm slack | assumed $1.50 | 150 | .59 | | |
| | 17 | 25 | 18.400 | 15 | 276,000 | " " | 1.50 | 46. | 1.63 | | |
| | 18 | 37 | 27.450 | 10 | 274,500 | " " | 1.50 | 56 | 1.34 | | |
| | 19 | 17. | 12.720 | 14.7 | 187,860 | " " | 1.50 | 64 | 1.17 | | |
| | 20 | 18. | 13.420 | 6.5 | 87,230 | " " | 1.50 | 62. | 1.21 | | |
| | 21 | 20. | 14.560 | 5.0 | 72,800 | " " | 1.50 | 40. | 1.87 | | |
| | 22 | 48. | 35.650 | 7.5 | 267,375 | bitm. block | 3.00 | 76 | 1.98 | | |
| | 23 | 33. | 24.605 | 10 | 246,057 | " " | 3.00 | 46 | 3.27 | | |
| | 24 | 20. | 15.000 | 9. | 135,000 | " " | 3.00 | 56 | 2.68 | | |
| | 25 | 20 | 15.200 | 6. | 91,368 | anthr. pea | 4.50 | 65. | 3.46 | | |
| | AVERAGES | | | | | | | 66. | 1.91 | | |
| ALTERNATING CURRENT | 26 | 26 | 19.000 | 8 | 152,000 | bitm. slack | 1.50 | 104 | .72 | | |
| | 27 | 295 | 220.000 | 9.5 | 2,090,000 | Indian block | 3.00 | 52 | 2.81 | | |
| | 28 | 66. | 49.220 | 16.0 | 785,920 | bitm. " | 3.00 | 121 | 1.24 | | |
| | 29 | 38 | 28.000 | 12.0 | 336,000 | " " | 3.00 | 96 | 1.56 | | |
| | 30. | 30. | 22.000 | 11.0 | 242,000 | " " | 3.00 | 76. | 1.98 | | |
| | 31 | 30 | 22.300 | 14.0 | 312,666 | anthr. pea | 4.50 | 108 | 2.09 | | |
| | 32 | 25 | 18.480 | 6.0 | 110,880 | " " | 4.50 | 110 | 2.05 | | |
| | AVERAGES | | | | | | | 953 | 1.79 | | |
| COMBINED SYSTEMS | 33 | 181. | 134.780 | 21.0 | 2,843,760 | bitm block | 3.00 | 104 | 1.44 | | |
| | 34 | 446 | 332.150 | 24.0 | 7,971,600 | anthr. scregs | 1.50 | 208 | .36 | | |
| | 35 | 32. | 24.100 | 15.5 | 373,520 | bitm slack | 1.50 | 111. | .68 | | |
| | AVERAGES | | | | | | | 141. | .83 | | |
| GERMAN PLANTS | Elberfeld | (direct current station) | | | 313,438 | | | | | | 5.70 |
| | Hamburg | " " " | | | 542,900 | | | 148 | | | 5.14 |
| | Cologne | (alternating cur station) | | | 307,074 | | | 71. | | | 6.65 |
| | Barmen | (direct cur. with accumulator) | | | 144,976 | | | 104 | | | 6.85 |
| | Hanover | " " " " | | | 452,526 | | | 219 | | | 5.02 |
| | Dusseldorf | " " " | | | 484,111 | | | 185 | | | 4.54 |

The division in the table shows the principal variation in the load, and it is interesting to note the change in cost per kilowatt hour produced, depending, of course, as it does upon the quantity of current delivered, as the cost remains practically constant, with the exception of the fuel. From 7:20 A. M. to 4:10 P. M., when the railway load is being

TABLE NO. 3.

| 24 HOUR TEST ON COAL. | Av'ge Gauge Pres. Lbs. | Temperature Feed Water. | Temperature Escaping Gases. | Duration Hours. | Average Watts. Railroad Circuit. | Average Watts. Incand'st Circuit. | Average Watts. Arc Circuit. | Horse Power Electrical. | Horse Power Indicated. | Per Cent. Loss. | Total Fuel Lbs. | Total Ash Lbs. | Total Combustible Lbs. | Cost Fuel. | Water Total Used Lbs. | Evaporation Per Hour Lbs. Actual Evaporation. | Factor Evaporation. | From and at 212°. | Per Lb. Fuel Actual | Per Lb. Fuel Equivalent 212°. | Com. H.P. 34½ lbs. water, hour 212°. | Cost per commercial horse power per hour Fuel. | Cost of fuel for period. | Total cost operations including labor | Total cost fuel and labor per kilowatt hour produced. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Coal. | | | | | | | | | | | | | | Cents. |
| Feb 2. 10-20 A. M. to 4-10 P. M. | 125 | 116° | 640° | 5.833 | 39215 | ..... | ..... | 52.56 | ..... | .. | 3264 | ..... | ..... | | 20626 | 3536 | ..... | 4052 | ..... | .. .. | 117.5 | .. ..... | $3.72 | $7.11 | 3.10 |
| 4-10 P. M. to 5-45 P. M. | ..... | 128° | 680° | 1.583 | 34100 | 34650 | 9180 | 104.46 | ..... | .. ... | 937 | ..... | ..... | | 7019 | 4433 | ..... | 5082 | ..... | ..... | 147.3 | ..... | 1.27 | 2.28 | 1.85 |
| 5-45 P. M. to 8-20 P. M. | ..... | 118° | ..... | 2.583 | 41360 | 38940 | 24140 | 140.00 | ..... | ... | 2502 | ..... | ..... | | 10849 | 6522 | ..... | 7474 | ..... | ..... | 216.6 | ..... | 3 04 | 4 13 | 1.53 |
| 8-20 P. M. to 12-00 M. | ..... | 116° | ..... | 3 666 | 26620 | 27170 | 24140 | 104.46 | ..... | .. ... | 2874 | ..... | ..... | | 21028 | 5735 | .... | 6571 | ..... | ..... | 190.5 | ..... | 3.79 | 5.33 | 1.87 |
| Feb. 3. 12-00 P. M. to 5-50 A. M | ..... | 110° | 620° | 5.833 | 2572 | 10611 | 8160 | 36.56 | ..... | .... | 3952 | . | | | 27845 | 4774 | ..... | 5471 | ..... | ..... | 158 6 | ..... | 5.03 | 6.26 | 3.96 |
| 5-50 A. M. to 7-10 A. M. | ..... | 116° | ..... | 1.333 | 24640 | 16500 | ..... | 55 74 | .... | ..... | 1049 | | .... | | 4544 | 3409 | ..... | 3907 | .... | ..... | 113.3 | ..... | .82 | 1.40 | 2 52 |
| 7-10 A.M. to 10-20 A.M. | 125 | 118° | ..... | 3.166 | 40480 | ..... | ..... | 54.26 | ..... | ..... | 1019 | | | | 14437 | 4559 | ..... | 5225 | ..... | . .. | 151.5 | .... .. | 2.60 | 3.97 | 3.08 |
| For entire run | 125 | 114° | 635° | 24.00 | ..... | .. .. | ..... | ..... | | .. | 15597 | 1719 | 13878 | $20.27 | 112348 | 4680 | 1.146 | 5364 | 7 20 | 8.25 | 155.5 | $.00543 | $20.27 | $30.48 | 2.45 |
| 24 HOUR TEST ON OIL. | | | | | | | | | | | Oil. | | | | | | | | | | | | | | |
| Feb. 6. 10-20 A. M. to 4-50 P. M. | 125 | 126° | 480° | 6.500 | 29631 | ..... | .... . | 42.2 | 63.3 | 33.2 | 1912 | ..... | ..... | | 23896 | 3677 | .... | 4184 | ..... | ..... | 121.3 | ..... | 4.08 | 8.80 | 4.31 |
| 4-50 P. M. to 5-55 P. M. | ..... | 124° | .. .. | 1 083 | 32436 | 35420 | 9180 | 106.0 | 137.0 | 22.6 | 371 | ..... | ..... | | 4944 | 4565 | ..... | 5195 | ..... | .... | 150.6 | ..... | 1 03 | 1.81 | 2.13 |
| 5-55 P. M. to 8-20 P. M. | ..... | 128° | 520° | 2 416 | 33573 | 39160 | 24140 | 128.0 | 158 0 | 19.0 | 1091 | ..... | ..... | | 15244 | 6310 | ..... | 7180 | ..... | ..... | 208.1 | ..... | 3.18 | 4.19 | 1.58 |
| 8-20 P. M. to 12-00 M. | ..... | ..... | ..... | 3.666 | 24192 | 27170 | 24140 | 100.0 | 130 0 | 23.2 | 1691 | ..... | ..... | | 10304 | 5282 | ..... | 6011 | ..... | ..... | 174.3 | ..... | 4.04 | 5.58 | 2.03 |
| Feb. 7. 12-00 M. to 5-50 A. M. | ..... | 116° | ..... | 5 833 | 660 | 16500 | 9180 | 35.3 | 86.9 | 59.4 | 1992 | ..... | ..... | | 23889 | 4096 | ..... | 4661 | ..... | ..... | 135.1 | ..... | 4 98 | 6.20 | 4 06 |
| 5-50 A. M. to 6-07 A.M. | ..... | 124° | ..... | .283 | 23980 | 16500 | 9180 | 77.0 | 107.0 | 28.0 | 115 | ..... | ..... | | 1648 | 5824 | ..... | 6627 | ..... | ..... | 192 1 | ..... | 34 | .40 | 2 50 |
| 6-07 A. M. to 10.20 A. M | 125 | 118° | ..... | 4.216 | 33920 | ..... | ..... | 42.2 | 63.3 | 33.2 | 1398 | ..... | ..... | | 14971 | 3551 | ..... | 4041 | ..... | ..... | 147.2 | ..... | 3.12 | $4.95 | 3.72 |
| For entire run | 125 | 122° | ..... | 24.000 | ..... | ..... | ..... | ..... | ..... | ..... | 8570 | .. | .. | $21.68 | 103956 | 4332 | 1.138 | 4930 | 12.13 | 13.80 | 142.9 | $.006324 | $21.67 | 31.93 | 2.83 |
| Feb. 14 and 15 24 HOUR TEST. Park Co. Coal. | .. | ..... | .... | 24.00 | ..... | .. | .. | ..... | ..... | ..... | 16930 | 2659 | 14271 | $2.15 T. $18.20 | 101854 | 4244 | As-s'med 1.138 | 4829 | 6.016 | 6.846 | 140.0 | $.005417 | $18.20 | $28.43 | ..... |

The last portion of table No. 2 is a synopsis of table No. 1. Table No. 3 is the result of three tests made under the direction of the writer on a combined electric and lighting station, to ascertain the relative economy on oil and coal for fuel. Inasmuch as the information is quite complete it has been thought advisable to insert it in this paper. The station consists of two compound condensing engines, coupled directly to a line shaft. This shaft runs two 90 kilowatt railway generators, two 16 kilowatt arc light machines, two alternating incandescent dynamos of 30 and 50 kilowatt capacity respectively, or a total capacity of 392 kilowats. The station is delivering but 1,248 kilowatt hours, showing that it is running considerably under loaded.

Figure No. 1 is a diagrammatic representation of the load during the 24 hours' run. The spaces between the vertical lines represent time and the horizontal lines horse power. The upper heavy line represents the total indicated horse power in the cylinders of the engine. The dotted line immediately below this represents the total electrical horse power delivered on the switchboard. The difference between these two lines represents the power lost in overcoming friction of engine, line shafting and the electrical losses in the dynamos. The third dotted line from the top represents the electrical horse power required by the arc and incandescent lights, and the lower dotted line represents the electrical horse power required by the arc lights alone.

Referring to table No. 3 it will be observed that the test began at 10:20 A. M. and continued for 24 hours. As the load in this station varied greatly, one of the objects of the test was to ascertain the cost of producing power during the different periods, and the right hand column in the table shows the total cost per kilowatt hour of the power thus produced.

The railway portion of this station operates from four to six cars, and during the time of the test but four cars were in operation. The cars started at 5:50 A. M. and ran until 12 o'clock midnight, and the lighting load was added as indicated by the figure.

The division in the table shows the principal variation in the load, and it is interesting to note the change in cost per kilowatt hour produced, depending, of course, as it does upon the quantity of current delivered, as the cost remains practically constant, with the exception of the fuel. From 7:20 A. M. to 4:10 P. M., when the railway load is being operated, the cost averages 3.1 cents per kilowatt hour, and from 12 o'clock midnight until 5 A. M. the cost per kilowatt hour is 3.96 cents, while during the heavy load, from 5 P. M. until midnight, the average cost per kilowatt hour is but 1.75 cent, and after deducting the labor, which is a fixed charge, the total cost per kilowatt hour for full load is but 1⅓ cent. After allowing for salaries, office expenses, loss in lines and depreciation in the plant, the figures show that this station is delivering current to the consumer for 6.4 cents per kilowatt hour, which corresponds fairly well with the figures given in table No. 2.

With a little calculation we see that this plant could have furnished 681 additional kilowatt hours, or over 90 additional horse power in motors, for ten hours from 6 A. M. to 6 P. M., for an additional cost of but $9.00 for fuel, or at a cost of one cent per horse power hour, and as a price of two cents per horse power hour can be obtained for motor work

there would be an additional revenue of $9 per day added to this station, assuming that all the motors were running fully loaded.

As a matter of fact the following statement shows approximately the average amount of power demanded from electric motors when running on various kinds of work: Wood working machinery, 40 per cent of rated capacity of machines in the plant; elevators, 80 per cent.; printing presses, 55 per cent.; machine shops, 40 per cent. or an average of about 55 per cent. On this basis this plant could drive safely 160 horse power in addition to its present railroad load, which, at 2 cents per horse power hour would bring an additional revenue of $33 per day, and deducting $9, the cost of fuel, leaves $24 per day additional net profit which this plant can be made to earn, provided the full capacity of the motors is paid for.

In case the additional load for electric motors is not available this extra 90 horse power could be utilized in driving an ice plant. In practice it takes about 2 horse power 24 hours to produce a ton of ice, and on this basis the available capacity of this plant would produce 20 tons of ice, which would sell for at least $2 per ton, making an additional revenue of $60 dollars per day for the plant, and after deducting for extra fuel, labor and depreciation, leaves $40 per day.

In closing this paper I will briefly call attention to the approximate results we are now getting from the different portions of power stations, and what we ought to expect from stations designed in the future.

First, Boilers. A large number of stations running now are using boilers with plain furnaces, from which they secure an evaporation of 5 pounds of water per pound of coal. By the introduction of water tube or internally fired boilers or tubular boilers set in improved furnaces, we will secure an evaporation of 8 pounds of water per pound of the same fuel.

Second, Engine and Generators. While we now get an average commercial efficiency of 60 to 70 per cent. in directly belted plants and 50 to 60 per cent. in those using shafting, we can increase these efficiencies to 70 and 75 per cent. respectively by the adoption of fewer and larger directly coupled units. This will not only reduce the cost of fuel and labor but will decrease the amount of real estate required and make the total investment less.

Third. While Europeans have recognized the advantage of the use of accumulators, with batteries as auxiliaries in central station work, we have been slow to see this advantage, but the tendency now among American engineers and central station men is to look with favor upon this adjunct, and as there are many cases wherein a battery plant as an auxilary can be made to pay well, the probability is that we shall see in the next five years many such plants installed. With a properly designed directly connected plant we may reasonably expect to deliver a kilowatt hour to the consumer in stations having a capacity of not over 1,500 kilowatts for 5 cents per kilowatt hour, which includes total cost of production and depreciation on the plant, but excludes interest on the investment and profit, assuming that a good quality of bituminous coal can be had for $2.50 per ton. In larger stations with cheaper fuel the cost can be brought to 3½ cents.

APPROXIMATE COST OF LABOR REQUIRED IN EVAPORATING 1,000 POUNDS OF WATER.

FUEL: OIL.

ONE BOILER HORSE-POWER EQUALS 34½ POUNDS OF WATER FROM AND AT 212°.

(Robert W. Hunt & Company's Table No. 4.)

| Horse-Power of Boiler. | Number of Boilers in Battery. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 75 | .06194 | .03097 | .02064 | .01548 | .01239 | .02048 | .01755 | .01536 | .01365 | .01228 |
| 100 | .04645 | .02322 | .01548 | .01161 | .00929 | .01316 | .01316 | .01152 | .01024 | .00921 |
| 200 | .02322 | .01161 | .00774 | .00504 | c0464 | 00658 | .00658 | 00576 | .00512 | .00460 |
| 300 | .01548 | .00774 | .00516 | .00387 | .00309 | .00438 | .00438 | .00384 | .00341 | .00307 |
| 400 | .01161 | .00580 | .00387 | .00290 | .00232 | .00329 | .00329 | .00288 | .00256 | .00230 |
| 500 | .00929 | .00464 | .00309 | .00232 | .00185 | .00263 | .00263 | .00230 | .00204 | .00184 |
| 600 | .00774 | .00387 | 00258 | .00193 | .00155 | .00219 | .00219 | 00192 | .00170 | 00153 |

$$\frac{\text{Cost of labor per month}}{26 \text{ days} \times 12 \text{ hours} \times \text{number of boilers} \times \text{number of thousand pounds of water evaporated}} = \text{approximate cost.}$$

(The above table is figured for a day of 12 hours. If cost is wanted for 8-hour day, add one-half more to given amount in table. The wages are calculated as follows: Fireman, $50 per month; water tender, $55.)

## Economy in the Boiler Room.[1]

By John C. McMynn.

I take pleasure in presenting before this body a few ideas on Economy in the Boiler Room. I say pleasure because I consider the boiler room one of the most abused portions of the system of power generation, and I sometimes wonder why the boilers do not form a union—and strike. Were such a thing possible, the list of grievances would probably read as follows: Non-union fuel—poor water—bad draft—inefficient attendance—out of date setting, and many other minor details.

Pardon me if in this short paper I do not follow a fixed outline, but rather talk along just as if we were discussing the subject in which I have become so greatly interested in the last two years. As most of us have plants under our charge or are interested in them, I shall not take up the subject of new boiler rooms except to say that experience has shown that it is by all means good business policy for the company to secure the services of some modern consulting engineer. The brick mason in your town will assure you on his honor (and he is doubtless sincere), that he knows all about boiler settings; in fact, has "set hundreds of them," but he is setting boilers the same to-day as he did ten or twenty years ago. I will venture the opinion that at least a saving of 15 per cent, can be effected in the setting of a horizontal tubular boiler. In looking over a series of boiler tests, I find that those boilers which are hung from I beams resting on columns and having at least a good six inch clearance between the sides and the walls give the best results, the reason probably being that much additional heating surface is brought into use and the gases have free access to the sides of the boiler.

The question of horizontal tubulars versus water tube boilers is one which every engineer and owner must settle for himself, for in solving the problem there are many variable quantities: First cost, cost of fuel, quality of fuel, amount of room, etc.

An easy way of figuring this out without considering safety is as follows:

Let B = cost of boilers.
" b = rate of interest on cost of boilers.
" P = cost of boiler plant exclusive of boilers.
" p = equal rate of interest on P.
" A = cost of attendance per horse power.

APPROXIMATE COST OF THE LABOR REQUIRED IN EVAPORATING 1,000 POUNDS OF WATER.

FUEL: COAL.

ONE BOILER HORSE-POWER EQUALS 34½ POUNDS OF WATER FROM AND AT 212°.

(Robert W. Hunt & Company's Table No. 3)

| Horse-Power of Boiler. | Number of Boilers in Battery. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 75 | .06194 | .03097 | .01548 | 03097 | .03593 | .03417 | 04425 | .03872 | .04061 | .04264 |
| 100 | .04645 | .02322 | .02941 | .02322 | 02694 | .02379 | .03318 | .02901 | .03045 | .03205 |
| 200 | .02322 | .01161 | .01471 | .01683 | .01347 | .01471 | .01957 | .01712 | .01754 | .01811 |
| 300 | 01548 | .01471 | .01032 | .01471 | .01827 | .01522 | .01526 | .01509 | .01514 | .01502 |
| 400 | .01161 | .01161 | .01122 | .01393 | .01370 | .01509 | .01459 | .01408 | .01380 | .01242 |
| 500 | .01765 | 01347 | .01486 | .01347 | .01635 | .01517 | .01552 | .01474 | .01507 | 01430 |
| 600 | .01471 | 01122 | .01238 | .01296 | .01362 | .01380 | .01294 | .01316 | .01256 | .01261 |

$$\frac{\text{Cost of labor per month}}{26 \text{ days} \times 12 \text{ hours} \times \text{number of boilers} \times \text{number of thousand pounds of water evaporated}} = \text{approximate cost.}$$

(The above table is figured for a day of 12 hours. If cost is wanted for 8-hour day, add one-half more to given amount in table. The wages are calculated as follows: Firemen, $50; coal-passer, $45; water tender, $55.)

" C = cost of compounds and incidentals per horse power.
" D = cost of repairs.
" Nu = horse power.
" Z = number hours plant runs per year.
" W = cost of fuel burned per horse power.

Then total cost per horse power hour would be:

$$\frac{(B + B\frac{b}{100}) + (P + P\frac{p}{100}) + NuAZ + CNuZ + D + WNuZ}{NuZ}.$$

Applying this formula to each particular location the economy can be calculated.

Generally speaking, it is economy to enlarge a plant and burn a cheaper fuel with less evaporation. The limit would be reached when the interest on the investment equals the saving per year.

I attach some tables which have been published in *Electrical Engineering*, but which I think are handy to calculate the cost of evaporating water with different grades of fuel.

The question of safety is a most important one, and is, of course, greatly in favor of the water tubes; but it is wonderful how few explosions occur from horizontal tubulars when one considers the attendance they receive in saw-mills and small isolated plants.

During the last few months none of us have been able to choose our fuel and hence have not run economically, as we have had to take what the "Union" was willing to give and render thanks accordingly. But the question of generating steam with oil, coal and gas is one which has been open for a long time. Oil undoubtedly is the nicer fuel, as it is smokeless and requires so little attention, but whether it is the more economical depends in the first place on the price, which is as variable as a monopoly can make it, and secondly, on the number of boilers in your battery. The attached tables are practically correct, as the cost of labor was calculated from actual experience and not for an ideal plant either in the case of oil or coal.

In Chicago gas is being used in many plants, but the Natural Gas company takes the contract by the year and has made some very moderate contracts for the first year, at least. In the Auditorium central plant, the chief engineer, Mr. Cowen, tells me that he will save about $6,000 per year by using natural gas. The boilers there were equipped with

COST OF EVAPORATING 1,000 POUNDS WATER.

FUEL: OIL.

(Robert W. Hunt & Company's Table No. 2.)

| Cost per Barrel of 42 Gallons. | | $ .20 | .30 | 40 | .50 | 60 | .70 | .80 | 90 | 1.00 |
|---|---|---|---|---|---|---|---|---|---|---|
| Cost per 100 Gallons of Oil. | | $ 4762 | .7142 | 9524 | 1.1904 | 1 4275 | 1 6666 | 1 9047 | 2.1427 | 2 3819 |
| Cost per 100 Pounds of Oil. | | $ 0006802 | .0010203 | .0013605 | .0017006 | .0020407 | 0023809 | .002721 | .0030611 | 0034013 |
| Pounds of water evaporated per pound of oil. | Cost of oil consumed in evaporating 1,000 pounds water. | | | | | | | | | |
| 10 | | .0680 | 1020 | 1360 | 1700 | .2040 | 2381 | 2721 | 3061 | 3401 |
| 11 | | .0618 | 0927 | .1236 | 1546 | 1855 | 2164 | 2473 | 2782 | 3091 |
| 12 | | 0566 | 0850 | 1133 | 1417 | .1700 | .1984 | 2267 | 2551 | 2834 |
| 13 | | .0523 | 0784 | .1046 | .1306 | .1569 | .1831 | 2093 | 2354 | 2616 |
| 14 | | .0485 | 0728 | 0971 | .1214 | .1457 | .1700 | .1943 | 2186 | 2429 |
| 15 | | .0453 | 0680 | .0907 | 1133 | 1360 | .1587 | .1814 | .2040 | .2267 |
| 16 | | .0425 | 0637 | 0850 | .1062 | .1275 | .1488 | .1700 | .1913 | .2125 |
| 17 | | .0400 | .0600 | 0800 | 1000 | 1200 | 1400 | .1600 | .1800 | .2000 |
| 18 | | .0377 | .0566 | .0755 | .0944 | .1133 | .1322 | .1511 | .1700 | 1889 |
| 19 | | .0358 | .0537 | .0716 | 0895 | 1074 | .1253 | 1432 | .1611 | .1790 |
| 20 | | .0340 | .0510 | .0680 | 0850 | .1020 | .1190 | .1361 | .1530 | 1700 |

42 × 7 = 294 = pounds of oil per barrel.

Let $x$ = cost per barrel. Cost of evaporating 1,000 pounds water = $\frac{1{,}000}{\text{evaporation}} \times \frac{x}{294}$

1. Read before the Northwestern Electrical association, St Paul, Minn., July 18, 1894.

mechanical stokers and when the strike was on only one grade of coal could be used, and, as many plants wanted this grade, the price went up to $4.10 a ton for slack coal. If a smokeless furnace is used it seems as if it should be one which can burn any grade of coal or shavings. The Pullman Palace Car company has made many improvements during the last year and are using the Hawley down draft with great economy, as it can burn the refuse of the wood working shops and shavings, or any grade of coal. The company also put in the Warren Webster vacuum system, and is now collecting all the returns which formerly went into the sewers.

In the modern boiler room one of the most important appliances is the feed water heater. The main points to be considered are: First, temperature as nearly 212° as possible; second, amount of exhaust steam necessary to heat water; third, ease of cleaning heater; fourth, low back pressure.

COST OF EVAPORATING 1,000 POUNDS OF WATER.

FUEL: COAL.

(Robert W. Hunt & Company's Table No. 1.)

| Pounds of water evaporated per pound of coal. | Cost of coal consumed in evaporating 1,000 pounds water. | Coal per Ton. $ 75 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.50 | 3 00 | 3.50 | 4.00 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | .0750 | .1000 | .1250 | .1500 | .1750. | .2000 | .2500 | .3000 | 3500 | 4000. |
| 5.5 | | .0681 | .0909 | 1136 | .1363 | .1591 | .1818 | .2272 | 2727 | 3182 | 3636 |
| 6. | | .0625 | .0833 | .1041 | .1250 | .1458 | .1666 | .2083 | 2500 | .2916 | 3333 |
| 6.5 | | .0576 | .0769 | 0961 | 1154 | .1346 | .1538 | .1923 | .2307 | 2692 | 3077 |
| 7. | | .0535 | .0714 | 0892 | 1071 | .1250 | .1428 | 1785 | .2143 | 2500 | 2857 |
| 7.5 | | .0500 | .0666 | 0833 | 1000 | .1166 | .1333 | .1666 | 2000 | 2333 | 2666 |
| 8. | | .0468 | .0625 | 0781 | .0937 | .1093 | .1250 | .1562 | .1875 | 2187 | 2500 |
| 8.5 | | 0441 | .0588 | 0735 | 0882 | .1029 | 1176 | .1470 | .1764 | .2059 | 2353 |
| 9. | | .0416 | .0555 | 0694 | .0833 | .0972 | 1111 | .1389 | .1666 | 1944 | 2222 |
| 9.5 | | .0394 | .0526 | 0657 | .0789 | 0921 | .1052 | .1316 | .1578 | .1842 | 2105 |
| 10. | | .0375 | .0500 | 0625 | .0750 | .0875 | .1000 | 1250 | .1500 | .1750 | 2000 |
| 10 5 | | .0357 | .0476 | 0595 | .0714 | .0833 | .0952 | .1190 | .1428 | 1666 | 1904 |
| 11. | | .0340 | 0454 | 0568 | .0681 | .0795 | 0909 | 1136 | .1360 | 1591 | 1818 |

Cost of evaporating 1,000 pounds of water = $\frac{\text{price of coal per ton}}{(2) \times \text{evaporation.}}$

There are so many first-class heaters in the market today than an engineer can find exactly what he wants by a little study. Of course different heaters are suited for different plants, and the needs of plants should be studied.

The higher the temperature of the feed water in the heater, the more scale will be deposited in the heater and consequently less in the boiler, which is a very desirable fact, for if an engineer knows exactly where the scale is deposited he can get at it regularly to remove it. The amount of steam necessary to heat the water of course depends largely on the conductivity of the material between the water and the steam, and if scale is deposited on this conducting surface, the heater will gradually but rapidly and surely lose its efficiency. A heater which cannot be cleaned of scale rapidly and easily will, of course, be neglected and allowed to become inefficient.

The reduction of back pressure is a most important item, for all the economy of the boiler room may be easily more than balanced by increase of back pressure in the engine room, and at the same time the efficiency obtained from well set valves and nicely adjusted engines is over balanced.

No other part of the supply business has been so disgraced as that of boiler compounds. It seems as if every quack remedy under the sun had been used for this, and it has become with many a mere matter of buying the engineer; and right here let me urge upon this association the necessity of honesty in the engineering profession. In my business as consulting engineer I hear that small sentence so often, "There's something in it for you," that I have made it a rule to deal with no agent who insults me in that way. If a thing cannot be sold on its merits, it becomes necessary to buy its acceptance, and I cannot express my contempt for an engineer who will accept pay for his services from his employer and then betray his trust by listening to the enticing conversation of money.

We have all of us used different compounds and, of course, been disappointed in some of them, but the new way is to analyze the water and have a compound made that will act to the best advantage on that particular water.

How many of you know exactly what it costs you to evaporate your water, and can distribute your station expenses? I heard of a new plant just about to be built which has large steel bunkers holding about ten tons each, which are placed on scales and feed directly onto the boiler room floor. From this arrangement the superintendent can tell at any hour if he wishes, exactly how much fuel has been used, and with a water meter can approximately arrive at the evaporation.

In making tests a water meter should not be used and the modern plant will always have two tanks large enough for measuring the feed water, so that the engineer can try different grades of coal and intelligently advise the purchasing agent.

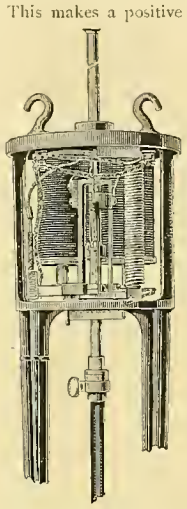
Connections should be so made that any one boiler can be tested or any combination. Blind flanges will not leak, but valves will in nearly every case.

A calorimeter is such a simple instrument that any engineer can run it and know what quality of steam he is supplying from the boilers. Thermometers should be placed in the feed pipes and watched closely. But intelligent attendance is about as important an item as any. High priced superintendents are a rule, but any "Dago" can shovel coal, and his idea of firing is to handle all the coal possible with the least effort. Raise the standard of labor in the fire-room and pay more wages, and I am sure you can reduce the number of men and save much in the fuel bill.

## Rushmore Arc Lamps.

The lamp shown in the illustration is designed to meet the requirements of a simple and durable lamp for street lighting on the constant current or arc dynamos. It is an improvement by reason of its extreme simplicity and solid construction, together with a clutch feed mechanism, that works with precision, even after very long use. While the lamp contains a number of new points, its most excellent features are due to the careful design and the proper adaptation of devices that years of service have shown to be the best. The entire lamp frame is a single and very simple casting, the feed clutch is very simple, and the electrical control of the feed is so powerful that it is not at all necessary to have the clutch in the best condition for an even feed, it is said.

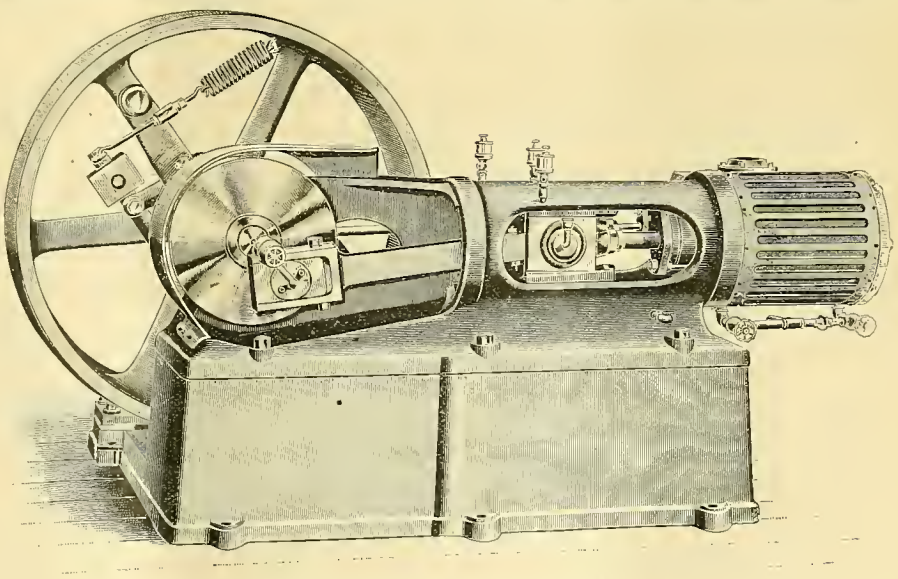
One of the greatest troubles with clutch lamps is the uneven wearing of the rod. In this lamp the rod is made of phosphor bronze, ensuring a much longer wear. The lamp has a positive cut-out that forms a part of the feeding mechanism, and when the carbons are consumed, the lamp is automatically short circuited in addition to the regular cut-out, so that there is no chance of an open circuit on the line. This lamp is made to burn 14 hours on any constant current circuit. It has a hand switch and is entirely waterproof. It is very neat in appearance for interior lighting.



RUSHMORE ARC LAMPS.

## Horizontal Racine Automatic Engine.

Owing to the demand for engines in places where a low ceiling precludes the use of an engine of the vertical type, the Racine Hardware company has designed and placed upon the market a horizontal machine which is built upon the same general design as its familiar vertical engine. It is of the high speed automatic type, and, as shown in the accompanying illustration, is characterized by extreme compactness and simplicity. One of the prominently noticeable features of the Racine engines is the outer support for the power wheels. The company argues that a self-contained engine saves much cost in the setting, and that outbearings provide additional safeguards against the shaft getting out of line from the upsetting of the foundation or other cause. The governor has a combination of weights, levers and springs, which together have such possibilities of adjustment as to cover a wide range of speed. The several parts of the Racine automatic engine are designed and put together with a simplicity, compactness and symmetry which are praiseworthy. All parts are made to standard gauges and are interchangeable. The valve is of the hollow piston type, perfectly balanced and fitted with rings which keep the joints tight and take up the wear as the surfaces wear down. Its average point of cut-off when the engine is giving its rated horse power is at one-quarter stroke, the remaining three-quarters of the piston stroke being accomplished by the expansive power of steam. Asbestos cement is packed around the outside to lessen condensation as much as possible and is covered with an iron jacket. The brasses of the connecting rod on cross-head pin are taken up by means of the wedge provided with double nuts. A steel key extending the full length of the lower half of the brass box is held in place by a steel pin which has a bearing on the steel wedge. This makes a positive adjustment easily accessible at all times. The brasses for the crank end of the rod are taken up by means of double nuts on the two studs, making both adjustments in the same direction.



HORIZONTAL RACINE AUTOMATIC ENGINE.

## Electric Lighting in San Francisco.

The city and county of San Francisco, under date of July 10th, advertised for proposals to light the outlayng districts of the city with 2,000 candle power arc lamps. In all 430 arc lamps are called for, which are to be lighted during the entire night, from one-half hour after sunset until one-half hour before sunrise, except during the night of full moon and the night preceding and the night following, when no lamps are to be lighted. A resolution was passed by the Board of Supervisors requiring that sealed proposals for carrying out this lighting should be submitted on July 16th, six days from the date when the advertisement first appeared. The contract is to be let for a period of two years on and from August 1, 1894, and a certified check for $10,000 in gold coin must be deposited with the clerk of the board with the filing of the bid, and, in addition, bidders must give a good and sufficient bond with two sureties

in the sum of $35,000 for the proper fulfillment of the contract. If the bidder shall fail or neglect to execute a written contract as provided within four days after the award is made, then that sum shall be paid into the city and county treasury as liquidation of damages for the failure and neglect. The proposal concludes with the significant notice: "No bids will be received or entertained from parties who estimate on any contingent event, or who can not comply with, or who are not prepared or qualified to carry out, the terms and conditions herein imposed."

Considering the fact that but 20 days will be allowed a competitor of the Edison Light & Power company for the completion of a plant and the securing of a franchise (that must be advertised 30 days), the erection of pole lines for many miles of circuits, and considering also the fact that no competing company has been able to secure a franchise in San Francisco; nor, under the clause quoted, is it possible for any competing company to obtain a franchise through the securing of a city contract, as such action would constitute a "contingent event," it is not probable that the monopoly of the Edison Light & Power company of San Francisco will be broken through any contract for municipal lighting. The present price paid by the city for these lights is 55 cents per lamp per night.

### Detroit's Street Car Lines.

Contractor Thomas Nevins of Orange, N. J., has purchased the street car lines in Detroit, Mich. The contract was signed a short time ago. Mr. Nevins had the option which expired on July 9th. English capitalists, it is said, were anxious to secure the roads, and induced the mayor of Detroit to delay granting the franchise beyond the time named, in the hope of defeating Mr. Nevins. Mr. Nevins will pay for the roads, which comprise 80 miles of tracks, 30 of which are already equipped with the trolley system, $8,250,000, $4,000,000 in cash and the balance in bonds.

### New Chicago Supply House.

It is now pretty well understood that Chicago is to have a new electrical supply house with large cash capital and experienced management.

## CORRESPONDENCE.

### New York Notes.

NEW YORK, July 23.—The general term of the Supreme Court has awarded to the members of the former Rapid Transit Commission $1,250 each for their services since October, 1892. For their work previous to that time each commissioner received $5,000. The commissioners were appointed on February 19, 1891.

Last Tuesday the new commission adopted the last formal steps that were necessary to bring the question of an underground system before the voters of the city in November next. The commissioners anticipate an affirmative answer to the question when it shall be submitted to the electors, and they are going ahead to perfect plans for the speedy construction of a rapid transit system once the assent of the citizens is secured. To this end Chief Engineer William Barclay Parsons has been authorized to go abroad and study the underground systems in operation in London and Paris, so that future action by the commission may be taken intelligently and the $50,000,000 of public funds that will be required be properly safeguarded should the city have to furnish its credit. The commission adjourned until the last Tuesday in September.

Francis D. Dowley, who was appointed receiver of the West Side Electric Light & Power company in 1889, has applied to the court for permission to have his accounts passed upon by a referee in order that he may distribute among the creditors about $2,000 which he still has in his possession for that purpose. His application has been granted by Judge Andrews, of the Supreme Court.

An order dissolving the Electric Construction & Supply company, which was formerly located at No. 18 Cortlandt street, was signed last week by Judge Andrews. The proceedings for dissolution were taken by the directors of the company, upon the consent of the stockholders.

A Brooklyn daily paper has discovered that the Edison company is advertising itself at the expense of the city and has devoted considerable space to advertise the company at its own expense by calling attention to the matter. The company used plain glass globes upon its arc lamps, and upon each of these globes, in large block letters, are the words, "Edison Company," which naturally cast strong magnified shadows upon the sidewalks and streets. The observing paper thinks that the Edison company should pay for its advertisement. W. F. O.

## PERSONAL.

The thanks of the council of the Society of Arts have been voted to W. H. Preece, C. B., F. R. S., for his paper on "Electric Signaling Without Wires.' Among the civil list pensions granted by the government during the year ended June 20th, is one of £50 to Samuel Alfred Varley, in consideration of his services to electrical science.

John N. Beckley, president of the Rochester, N. Y., Railway company, and family spent last Sunday in Chicago.

Dr. A. H. Hoyt, general manager of the Whitney Electrical Instrument company, Penacook, N. H., is in Canada upon a combined business and pleasure trip.

A. L. Millard, the popular traveling representative of the Electric Appliance company, Chicago, has been in Chicago for a few days. Mr. Millard reports an active business.

Horatio A. Foster has taken charge of the editorial columns of *Electric Power*. Mr. Foster is at the present time chief assistant to Prof. George Forbes, and will continue in that position.

## ELECTRIC LIGHTING.

Hansom cabs are about to be introduced in Paris, the town council being willing to encourage the enterprise on the following conditions: 1 franc fares, no obligatory tips; guttapercha tires on the wheels, electric light, and right granted to fares to take parcels or valises for nothing.

E. J. Whitson, electrician of the Light & Fuel company, Grand Island, Neb., announces that on July 10th the arc lights were turned off. The company has been receiving $16 per lamp per month, but this year offered to charge only $15. The council would only pay $12 per month and the current was consequently shut off.

The Western Electric company, Chicago, has brought suit against William M. Williams of Milwaukee, Wis., for $8,800, which it is claimed is due on six promissory notes. The plaintiff wants a receiver appointed to take possession of the South Milwaukee electric light plant and some land in Oak Creek, which are concerned in the action.

G. W. and I. D. Hamilton, have secured a 10 years' franchise from the town of South Haven, Mich., for furnishing electric lights to the city, as well as for commercial use. George W. Furbeck, Monadnock building, Chicago, the president of the South Haven Electric Light company, desires bids for the necessary machinery and construction material for the plant.

The bids of the companies for the electric and steam plants for the new electric lighting station in Kalamazoo, Mich., have been received and examined by the city council committee on city lighting. The Fort Wayne Electric corporation, the Commercial Electric Engineering company, the Western Electric company and the Brush Electric company were in the field for the work, which includes supplying 170 2,000 candle power arc lights, burning 275 nights in the year. A proposition was also made by the Kalamazoo Electric company. Among the bidders for the engine work were the Edward P. Allis company, the Hamilton Engine company, the Nordberg Manufacturing company, the Watertown Steam Engine company, the New York Safety Steam Power company, the Buckeye Engine company and the Ball Engine company. Action has been deferred for some time.

## ELECTRIC RAILWAYS.

Crisfield, Md., wants an electric railway.

It is rumored that an electric railway will soon be running in Celina, O.

Mahoney City, Pa., and Shenandoah are now connected by a new electric railway.

A contract for the electric street railway at Belleville, Ont., was signed June 25th.

The work of converting the cable railway at Sioux City, Ia., to an electric system is nearly completed.

It is proposed to build a new electric line from Kingston, N. Y., to Ellenville, through Rondout Valley.

The Paterson, N. J., & Garfield Electric Railway company is making preparations to double track its road through Passaic City, having been granted that privilege by the council.

The French Thomson-Houston company has secured the contract for the construction of an electric tramway at Montpellier, and also the contract for converting several of the horsecar lines at Roubaix into electric tramways. The Lyons Oullins electric tramway is to be extended to Saint-Genis, Laval.

The North Chicago Street Railway company has applied to the Department of Public Works for a permit to lay tracks and string trolley wires on North Clark street, between Dewey court and Lawrence avenue. A protest from citizens living on the street had previously been filed in the commissioner's office, and that official refused to issue a permit unless the company agreed to place the poles in the center of the street. The intention of the company is to connect the North Shore electric line with the cable system.

At the annual meeting of the Union Electrical company of Berlin, held recently, it was stated that the company, which exploits the Thomson-Houston system in Germany, had, during 1893, completed electric tramways on that system at Bremen and Remsteid. During the same year work was also commenced of a similar character at Hamburg, Erfurt, and Gotha. The company had recently received a further contract for constructing an additional 70 kilometers of tramway at Hamburg for electric traction, the commission including the supply of 105 motor cars.

## TELEGRAPH.

The Halifax, N. S., board of trade has unanimously passed a resolution asking the Dominion government to subsidize an extension of the Bermuda cable to Jamaica.

The firm of Pirelli & Co. of Spezia, Italy, the first to start a submarine cable works on the continent, has a contract on hand, dating from 1887, to keep all the cables of the Italian government in repair for a period of 20 years. The works are able to produce six miles of submarine cable per day and the same quantity of underground lead protected cable. The company made a profit, it is said, of £18,696 last year, which admitted of a dividend of 8 per cent. being declared.

The increase made July 11th in the listed Western Union stock of $550,000 has been made in consequence of the acquisition of the American Rapid Telegraph company. This company had $3,000,000 stock and $3,000,000 bonds, and was for a considerable time operated by the Western Union Telegraph company under a lease at an annual rental of $60,000 per annum. It was recently sold under foreclosure, and was bought by a committee of bondholders and subsequently sold to the Western Union company. The additional stock listed has been issued in payment therefor.

The cable steamer, Britannia, arrived recently at Heart's Content, a seaport of Newfoundland on the southeast side of Trinity Bay, having on board about 190 miles of cable, the shore end of the new Anglo-American cable. The steamer after receiving a supply of coal started to lay the shore end of the cable and outward. She was accompanied by the Scotia, which, when she receives the end of the cable to be spliced from the Britannia, will begin to pay out the deep-sea cable, the Britannia meantime proceeding to London to recive the final section, returning in time to meet the Scotia, when the undertaking will be completed. The new cable is the largest in the world, and considerable interest has been manifested in the completion of the work.

## MISCELLANEOUS.

The Bonet electric tower which was exhibited at the Midwinter Fair, will remain in San Francisco.

Senator Peffer's bill to reward an invention that would utilize electricity or gaseous vapor as a motor for agricultural machinery has passed the Senate.

The fourth annual meeting of the American Electro-Therapeutic association will be held in New York on September 25th, 26th and 27th, at the Academy of Medicine.

The Fulmen accumulator is now being exploited in France by a company with offices in Paris. These accumulators are intended both for lighting and for traction purposes.

An exhibition of plans for a maritime canal between the Bay of Biscay and the Mediterranean was opened in Paris recently by a society of promoters. Some competitors propose that vessels should be transported by railway or by rolling docks propelled by electricity.

Several numbers of the electrical engineering leaflets series edited by E. J. Houston and A. E. Kennelly have appeared. Thus far the pamphlets have dealt with electrical effects, elementary force and electric resistance, clearly described for popular study. The leaflets are issued each week by the *Electrical Engineer* of New York and are prepared in such a form that they may be readily bound.

Paper poles for telegraphic and other electric wires are the latest development of the art of making paper useful. These poles are made of paper pulp, in which borax, tallow, etc., are mixed in small quantities. The pulp is cast in a mold, with a core in the center, forming a hollow rod of the desired length, the cross pieces being held by key-shaped wooden pieces driven in on either side of the pole. The paper poles are said to be lighter and stronger than those of wood, and to be unaffected by sun, rain, dampness, or any of the other causes which shorten the life of a wooden pole.

The *New Science Review*, a miscellany of modern thought and discovery, published by the Trans-Atlantic Publishing company, Philadelphia, has made its appearance. The new magazine, it is announced, differs from other scientific magazines in that it does not attempt to supersede the older and more conservative periodicals, but to supplement them. The publication will be issued quarterly. This first issue of this review contains an interesting paper upon "Nikola Tesla and His Works" by Lieutenant F. Jarvis Patten.

A gas engine installation has been laid down at Carrignan, in the Ardennes, in which poor or inferior gas is used for the engine. According to the *Genie Civil*, the gas engine employed is of the Delamare-Debouteville and Malandin type of 60 effective horse power; the gas producer is of the Buire-Lencauchez class, gassifying small coal, and the consumption is 650 grammes per effective horse power. The generating station contains the gas engine and dynamos. There are three dynamos of a total capital of 35 kilowatts, and these are used either to charge accumulators or to supply current direct for lighting.

At the Krupp Works, Essen, Prussia, experiments have been made with the process, invented by M. Lagrange and M. Hoho, for heating metals by the electric current for welding, tempering or hardening. A tank lined with lead contains acidulated water, the positive pole of an electric battery being put in connection with the lead lining, and the negative pole with the tongs, the handles of which are made of a non-conducting substance. When a piece of iron is seized by the tongs and plunged into the water, the current decomposes the liquid, hydrogen forming at the end of the conductor connected with the piece of iron, and forming round it a coating of gas; and the resistance which is thus opposed to the current causes the heating of the iron.

## TRADE NEWS.

The Chicago Water Motor & Fan company, 101 Lake street, Chicago, has recently installed a 42 inch exhaust fan in the establishment of Philip Henrici, the caterer. The fan is to be driven by a two horse power motor.

The Mather Electric company, Manchester, Conn., is receiving encouraging orders for its new directly connected and belted generators, both for lighting and railway work. The

capacity of this company to turn out first class and highly efficient apparatus, gained by 14 years' experience in the business, suffices to insure a purchaser's confidence. J. Holt Gates, 1139 and 1140 Monadnock building, Chicago, general western agent, reports a growing steady business.

The Collyer Insulated Wire company, Pawtucket, R. I., has recently been increasing its output by adding new machinery and has been obliged to work over time to keep pace with the orders, of which, it reports, a large share came from the western states.

Roth & Eck, 30 Market street, Chicago, manufacturers of fan motors, dynamos and motors, report an excellent sale of their popular type of fan motor during the season. They will soon place on the market a new type of dynamo for small plants, which is said to be very efficient. A circular will be mailed upon application.

The Westinghouse Electric & Manufacturing company has issued a book calling attention to its stopper incandescent lamp. The book illustrates the lamp, its process of manufacture and some of the lighting schemes in which it has been employed. A price list is included in the reading matter and a history of the lamp at the World's Fair stated.

Grant gears, manufactured by George B. Grant, Lexington, Mass., have gained an excellent reputation in electric light plants and the demand for them continues brisk. Those desiring information regarding gears of any kind may apply to this well-known manufacturer, who will be glad to send a full explanatory catalogue, besides giving any special information desired.

The St. Louis Railway company, St. Louis, Mo., has placed the order for its new car barn with the Berlin Iron Bridge company, East Berlin, Conn. The building will be 64 feet in width and 185 feet in length, with brick walls, the roof being of iron, covered with the Berlin Iron Bridge company's patent anti-condensation corrugated iron roof covering. It is the intention of the railroad company to make this station absolutely fire-proof. There will be no woodwork used in the construction of the building, and it will not be necessary to carry any insurance whatever, as the danger from fire is consequently eliminated.

"Modern Turret Lathe Practice" is the title of a publication which the Gisholt Machine company, Madison, Wis., will issue each month. In this pamphlet will be given illustrations of some of the uses to which the company's turret lathes are put. The range of application of the turret lathe is so large, and many of the most successful operations are so different from accepted practice that it is thought that this publication will be cordially received by superintendents, foremen and proprietors of manufacturing machine shops. The illustrations will be taken from current practice and will represent the company's latest productions.

A new catalogue has been issued by the Sebastian Lathe company, Cincinnati, O., calling attention to the improvements that have been made in its line of tools, and also to those added since the company's last catalogue was issued. Its increasing trade encourages the company in the belief that the workmanship and design of its tools are appreciated and satisfactory. Every machine is subjected to a careful inspection and actual operation before being shipped from the factory, which is equipped with the latest and most approved machinery, specially adapted to the work proposed, and employing the most skillful labor. A specialty is made of engine and speed lathes, planers, shapers, drill presses and machinists' tools and supplies.

Ever since its formation the Metropolitan Electric company, Chicago, has been adding to the list of specialties which it handles, new goods which have seemed to give promise of particular merit. Among these has been a number of devices pertaining to electric street railways, until the company finds itself in a position to warrant its entering that field. It has now in preparation a special catalogue of its street railway appliances, which will shortly be issued, and which will show and describe the street railway supplies and specialties which it comprises in its list. Some of these are line material, the Knox circuit breaker, the Lowell wrench, the Hercules trolley clamp, the Gibbs trolley, I. X. L. wire, P. & B. compounds, lightning arresters, etc.

The idea of teaching by systematic correspondence, the foundation of which was laid at Chautauqua, N. Y., in 1873, has presented the opportunity to many men in this country of securing a thorough and technical education, who would have been unable to devote the time and money to a course of training in a school or college. One of the most successful institutions of this kind is the Correspondence School of Mechanics and Industrial Sciences and the Correspondence School of Mines, Scranton, Pa., both schools being conducted by the Collier Engineer company. This institution has the names of more than 4,000 students upon its books, a significant testimonial of the value of the instruction it gives. The plan of the school briefly stated is: To facilitate systematic study under competent instructors who direct and aid the student through the mails. Instruction and question papers are prepared for the technical courses upon unique plans as text books. These are written in clear and concise language as free as possible from technicalities and begin at the beginning of each subject. They explain principles and details and how to apply them. All unnecessary matter is omitted. Special information is furnished students as often as desired on blanks supplied by the school. To enroll students need only to know how to read and write the English language. Diplomas are awarded to those who, having gone through one of the courses of instruction, pass a final examination. The advantages pointed out for such a system are numerous. Workers and busy people can obtain a knowledge of the theory of their trades. All the work is written and is more likely to be remembered than oral work. Students must be thorough, as they cannot advance unless they are proficient in preceding lessons. The students learn to express themselves clearly and concisely, and the practice in writing answers to questions is of great value to those required to stand written examinations. The instructor deals individually with the student and can better assist and encourage him than if he were one of a class being taught collectively. The prices of scholarship for the technical courses taught are not as great as the cost of the ordinary text books. The student, in addition, is directed and assisted by competent instructors. The school is not intended to fill the place of the regular technical schools, but to meet the requirements of those who cannot possibly attend them. The expressions of opinion of the students who have taken a course in this school are most flattering to the instructors and their methods.

## BUSINESS.

The United Electric Light, Heat & Power company, New York, is putting up a new switchboard building which will be covered with an iron roof and the Berlin Iron Bridge company's anti-condensation corrugated iron roof covering.

The Buckeye Electric company has appointed the Manhattan General Construction company, 50 Broadway, New York, its present agent for New York and vicinity, the exclusive agent for Massachusetts, Rhode Island and Connecticut, in addition to the territory already covered.

John P. Coghlin, manager of the Columbia Electric company, Worcester, Mass., announces that his company has just been awarded the contract for the electrical work upon the Westboro Insane Hospital, Westboro, Mass. The contract includes dynamos, wiring and between 800 and 1,000 lights.

The Hartley Electrical Works, 373 Dearborn street, Chicago, which do a general electrical repairing business, report an excellent business the last month. Converter repairs have been especially numerous. The works have excellent facilities for turning out this class of work promptly and satisfactorily.

The Electric Appliance company, Chicago, reports the demand for its well-known Paranite high grade wire to be steadily on the increase. Paranite is becoming particulary popular with the trade in general all over the West. Aside from the merits of the insulation this is due possibly to the fact that it is the only high grade rubber covered wire manufactured in the West, which leads to its support partly through local pride and also from the fact that all kinds of special orders can be furnished promptly, thus doing away with the delay in transit incurred where special orders have to be made up at eastern factories.

The Berlin Iron Bridge company of East Berlin, Conn., has received the contract for a new electric light and power station for the Bradford Electric Light & Power company, at Bradford, Pa. The building is 65 feet wide and 160 feet long, with brick side walls, the roof being of iron, covered with the Berlin Iron Bridge company's patent anti-condensation corrugated iron roof covering. The Berlin company has also recently received the contract from the Delaware, Lackawanna & Western Railroad company for one of its patent anti-condensation iron roofs to cover the new engine room at the Auchincloss shaft. This is the third roof of this kind that the Delaware, Lackawanna & Western Railroad company has bought of the Berlin company.

The new firm of Lee & Collins has taken offices at 615 Medinah building, Chicago, and will act as manufacturers' agent for high-class electrical goods. C. E. Lee has represented in Chicago a number of electrical manufacturing establishments for several years, and L. W. Collins has made a wide acquaintance in the electrical fraternity through his connection with electrical journalism. With two such well-known names in a firm it is safe to prophesy its success in its particular field. Among the specialties which Lee & Collins will handle may be mentioned the Hayden-Booker battery, Samson battery, Leavitt battery motors, Abatis annunciators, Collins' Compound (insulating and preservative paint), Favorite tape, L. C. splicing compound, Bernard porcelain cleat, Bernard commutator compound, and Bernard "Powers" arc cut-out. Battery material will also be handled by the firm.

On August 1st the Harrison International Telephone Construction company, Chamber of Commerce building, Chicago, will commence to book orders for the Ford automatic switchboard. By the use of this device it is possible to do away with the expense of a central office, to have absolute secrecy in the transmission of messages and the certainty of securing perfect connection, with the liability to error in wrong connection reduced to a minimum. The company is now establishing state sub-construction companies, and has issued a list of testimonial letters to which has been added the following notice signed by the company: "In consideration of the person owning or leasing this telephone, giving immediate notice to the undersigned of the commencement of any action, claiming this instrument to be an infringement upon other patents, the undersigned agrees to defend the same at its own cost and expense, and to pay all damages recovered."

Porter & Buerdorf, 808 Bort building, Chicago, have been made sales agents of the Detroit Electrical Works, and the firm has entered the field by securing a large contract in Chicago. The firm is calling attention to the record made by the Detroit single reduction motor for May, 1894, on the lines of the Detroit Street Railway company. The record was kept of the cost of repairs upon the motors of 12 cars, and showed an expense of $137.21 upon a total of 36,149.48 miles. The average number of miles per car was 3,012.45; average cost of repairs per car, $11.43; average mileage per car per day, 97.17; average cost of repairs per car mile, .00379. The firm feels that this is a noteworthy record, and supplements it by another upon the same lines for four months, January, February, March and April, which shows an average per car per day of 91.69, 102.84, 105.61 and 114.48, miles with a corresponding average of repairs per car mile of .00485, .00451, .00135 and .00222. Porter & Buerdorf will also handle storage batteries for traction work and lighting.

The railway apparatus built by the Card Electric company, Mansfield, O., is attracting considerable attention. The controlling stand, the company states, has made quite a hit on account of its simplicity. It consists of a central shaft on which are placed eight cams insulated by hard rubber tubing and held in place by hard rubber pins. Opposite each cam is a switch fastened by a bracket to the back, near the shaft. Each switch is provided with contact pieces to engage with clips on binding blocks fastened to the back. The controller simply consists of a series of break switches, doing entirely away with inefficient sliding contacts, etc. J. Holt Gates, 1139 and 1140 Monadnock building, Chicago, general western agent, reports many inquiries and an encouraging amount of work on hand. A recent catalogue issued by this company is very tasteful and carefully prepared and gives full details on both motor and accessory apparatus. Card motors have been in operation for some time in Fremont, O., and Mansfield, O., where they have given entire satisfaction, it is said.

S. N. Rushmore, 125 Liberty street, New York, announces that his factory in Jersey City, N. J., is completely filled with orders for arc lamps, search lamps, commutators and heavy dynamo repairs. He has just closed the contract to rebuild the dynamos of the North Attleboro Steam & Electric company of Pawtucket, R. I., whose station was burned last February. He has also arranged to rebuild the machines that were but slightly damaged by the burning of the station of the Electric Power company at St. George, Staten Island. Mr. Rushmore has orders on hand for 12 search lamps and mirror projectors. Six search lamps are for the Southern Pacific Steamship company, which will equip all of its steamers, and a number to some of the most prominent yachtsmen on the Atlantic and in the west. He has sold a number of search lamps wound for 500 volt current to railroad companies for exhibition purposes. It has been necessary to put in additional special machinery, and the force will be increased. Mr. Rushmore reports great success with the new spiral armature winding for low tension station machines.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued July 17, 1894.*

522,964. Manufacture of Incandescent Electric Lamps. Henry D. Burnett, Lynn, Mass., and Samuel E. Doane, Swampscott, Mass. Application filed December 3, 1892.

The invention comprises a fork for the manufacture of incandescent electric lamps, provided with a screw-threaded tang and a handle of non-conducting material having a screw-threaded socket to engage with the tang; and its object is to cheapen and facilitate the work.

522,972. Thermostatic Alarm. Charles Cuttriss, New York, N. Y. Application filed October 26, 1893.

The device described is intended to be an improvement in thermostatic alarm systems of such a character that will not remain inactive through all variations of temperature up to the normal limit for which it is adjusted, a defect noticed in many existing devices.

522,983. Galvanic Battery. Gardner Hewett, New York, N. Y. Application filed September 19, 1893.

The objects sought to be attained are to produce a battery giving a large current for a long period of time; one which is cheap and simple to construct, and in which the elements are so arranged and constructed as to maintain a well defined "gravity line."

522,986. System of Electric Distribution and Generation. Edwin J. Houston, Philadelphia, Pa. Application filed November 17, 1887.

The invention provides a means by which currents developed by a prime generator of very low electromotive force may be economically converted into currents of any desired electromotive force. The inventor passes current from some source capable of generating electric currents of great quantity but low electromotive force through the primary of an induction coil of any of the well known forms. This current is caused to vary in intensity or direction by any of the well known methods, such as are employed in connection with induction coils, so as to develop secondary currents of higher electromotive force in the secondary coils of the induction apparatus. At the same time the secondary coils of the induction apparatus are provided with a suitable commutator acting in unison with the devices providing changes in the direction or intensity of the primary current, so as to turn into one and the same direction the high potential alternating currents developed in the induction apparatus.

522,988. Method of and Apparatus for Transforming Alternating into Continuous Currents. John F. Kelley, Pittsfield, Mass. Application filed January 6, 1894.

The invention is in part effected by the combination with an alternate current coil *D*, divided into sections, the number of turns of each being such that the amount included in any number of sections counting from the end next the largest is to the whole conductor, as the sine of 3.1416 times the number of sections considered divided by twice the whole number of sections is to unity, of a series of contact plates forming the terminals of the sections, a continuous contact plate *f*, brushes *k*, *k*, means for moving these brushes over the plates, so as to collect a unidirectional current varying as the sine squared of the angle traversed by the inducing coil of the generator, a second conductor and commutator similar to the first, but delivering an

electromotive force varying as the cosine squared of the angle, traversed by the inducing coil and connections between the two sets of brushes, by means of which the two currents are superimposed. S is a small synchronous motor for turning the brushes; also the combination with two sources of alternating currents which vary respectively as the sine and cosine of the same angles of two conductors or coils connected to the sources, means for collecting from the coils alternating electromotive forces varying as the sine squared and cosine squared of the same angles, commutators for correcting or straightening such currents and electrical connections for combining them into a single current.

522,999. Electrical Connection Cord. Alfred H. McCulloch, Boston, Mass. Application filed February 6, 1894.

An electrical connecting cord is patented in which the conducting portion has pliability in the highest degree, so that it can be bent in any direction and to any extent without fracture or rupture, and to this end the invention consists in the employment of a column or thread of mercury or other fluid conducting material confined in a suitable containing tube, and in providing suitable devices at each terminal, by means of which the mercury is brought into electrical contact with binding posts or with electrical apparatus or conductors of any kind.

523,019. Commutator for Dynamo-electric Machines. Elihu Thomson, Swampscott, Mass. Application filed February 10, 1894.

The invention relates to commutators for dynamo-electric machines, and has for its object to provide a ready means of renewing the insulation between the segments or of correcting the defects in the face of the commutator by removing a few of its segments without turning down the whole commutator, to which ends the commutator is divided into a set of sub-segments and a set of wearing or surface segments upon which the brushes bear, and insulate the various parts from one another in a novel manner.

523,027. Armature Bar and Method of Making Same. George Weber and Charles W. Marcley, Rotterdam, N. Y. Application filed December 23, 1893.

The invention has for its object to provide an efficient and economical method of insulating armature bars, particularly such as are used in the construction of large armatures designed for heavy currents.

523,055. Process of Making Battery Plates. William L. Silvey, Dayton, O. Application filed September 9, 1892.

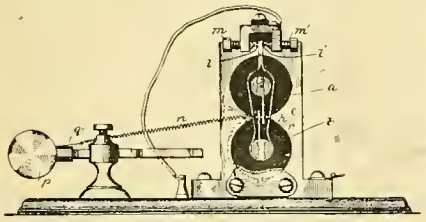
The invention relates in part to a new article of manufacture in the way of battery electrodes, which are peculiarly adaptable as both the positive and negative elements of a storage battery. It also relates to electrode plates or supports, primarily coated or combined with active material, or material adapted to become active, which active material is prepared by electrical decomposition or disintegration, and deposited by electrical deposition.

523,074. Electric Switch. Jesse F. Kester, Buffalo, N. Y. Application filed November 28, 1893.

It is the object of the invention to produce a switch designed for throwing electric apparatus in and out of circuit, in which the terminals are prevented from welding together; to construct the pivot of the switch levers in such a manner that heating of the joint is prevented and to detachably secure the contact plates to the switch lever, so that they can be easily renewed when worn or burned.

523,104. Electric Railway Supply System. William A. Butler, New York, N. Y. Application filed March 16, 1894.

This invention relates to that class of electric railways in which the current for the motor on the car is taken from an overhead conductor or series of electrically charged contacts by a contact shoe or device carried above the car, but it is distinguished from the ordinary overhead trolley system in that the overhead charged contacts, from which the current is taken, are located at intervals, and the contact brush or device carried above or at the top of the car is at such length as to make contact with one of such devices before leaving another, so as to maintain a continuous circuit or supply of current through the motor.



NO. 523,119.

523,119. Quadruplex Neutral Relay. Charles D. Haskins, Brooklyn, N. Y. Application filed April 3, 1893.

It is the object of the invention to obviate false signals in quadruplex telegraphy, and it consists in providing a neutral relay with an armature which is surrounded by practically the same electrical influence as surrounds the electro-magnet with which it works. The magnets *a b* shown in the drawing are mounted within a frame *c*. The magnets are of the usual differentially wound type. The cores of the magnets consist of rods which project beyond the magnets and the frame *c*. The core of the upper magnet *a* is held stationary. The lower core of magnet *b* is allowed freedom of motion within the spool. This core is preferably mounted at its ends upon pivot screws. By means of this method of mounting the core is capable of rotary movement. This rotary movement, however, is limited by the lever *k*, which is screwed upon one end of the core. The upper end of this lever *k* is provided with contact points *l l'*, and is limited in its movement by the contact screws *m m'*. Point *l* is caused to rest normally upon contact screw *m* by means of a retractile spring *n*, which is attached to the lever *k*. The retractile force of this spring is controlled by means of the thumb-screw *p*, to the shank of which is attached the other end of the spring *n* by means of the cord *q*. Extensions *r* of the magnet core are provided, which are adapted to attract extensions *s* of the armature core, which are preferably symmetrically placed with relation to the extensions of the magnet core. This construction practically results in the production of two electromagnets, one of which, with its core, is fixed, while the core of the other is adapted to have a rocking movement.

523,120. Electric Signaling Apparatus. William W. Hibbard, Rochester, N. Y. Application filed August 12, 1893.

This improvement relates to electric signals, more particularly fire alarm signals, and consists of a system embodying a main line provided with suitable signal boxes, the main line being normally closed, a relay with sub-circuits connecting therewith, a differentiating instrument by which the currents through the several sub-circuits are changed, and other connecting mechanism of novel design.

523,121. Electric Signaling Apparatus. William W. Hibbard, Rochester, N. Y. Application filed August 12, 1893.

This patent is granted upon the same general system as that included in the preceding patent to the same inventor.

523,122. Differentiating Apparatus for Electric Signal Systems. William W. Hibbard, Rochester, N. Y. Application filed August 12, 1893.

This improvement relates to electric signaling apparatus, and consists of a differentiating apparatus located at the central station, capable by its action of changing the circuits, thereby enabling signals to be sent over the main line to different points, such as fire and police departments, without interference or difficulty.

523,123. Electric Signal Box. William W. Hibbard, Rochester, N. Y. Application filed August 12, 1893.

In this patent is described the combination, with a main circuit composed of two wires, of a signal box attached thereto a tripping device connected with one wire and suitable electrical connections, the whole capable, when in action, of opening the wire, translating a signal over the other wire, and of closing the first wire again after transmitting the signal.

523,124. Electric Signal Box. William W. Hibbard, Rochester, N. Y. Application filed August 12, 1893

Claim 1 reads:
In an electric signaling apparatus, the combination, with a main circuit composed of two wires and a lateral circuit provided with thermostats and manuals, either or both, of a box connected with the wires provided with an insulated face, a set of conducting blocks connected therewith, a movable arm provided with contact points resting in line with the conducting blocks and capable of changing the circuits by moving from one block to another, and suitable electrical connections connected with these blocks.

523,132. Magneto Call Box. Charles E. Scribner, Chicago, Ill. Application filed November 6, 1891.

This invention relates to signaling apparatus for sub-stations of telephone exchange systems, its object being to provide a novel form of calling apparatus, with appropriate circuits adapted to be self-protective from discharges of lightning or heavy currents.

523,140. Electric Motor. Julian F. Denison, New Haven, Conn. Application filed April 6, 1894.

The motor described in the specification is designed more especially for driving ceiling fans, and is therefore constructed in such manner that it may be suspended by a suitable support, the fan blades being connected with the lower end of the vertical armature shaft.

523,144. Electric Arc Lamp. Walter E. Frost, Lewiston, Me. Application filed July 31, 1894.

This invention comprehends two guide-ears or other equivalents extended at one side of the clutch plate, and which act to prevent sidewise tipping or tilting of the clutch plate, whatever be the form of the latter, the clutch rod thereby acting as a guide to prevent lateral tilting of the clutch plate, so that the latter can be tipped into an angular position with relation to the rod only in one direction

523,146. Conduit Electric Railway. Charles D. Jenney, Indianapolis, Ind. Application filed March 5, 1894.

Improvements are claimed in an electric conduit railway system upon devices for flexibly supporting the conductor bar, so as to be unaffected by the unequal motion of a car as well as several forms of novel construction.

523,160. Electrical Conductor. Gilbert H. Blakesley, Bristol, Conn. Application filed April 7, 1893.

A flexible electrical conductor consisting of a body of flat tape, into the edges of which are incorporated previously insulated wires or cables for transmitting electricity.

523,161. Means for Ventilating Armatures. Thomas C. Coykendall, Rondout, N. Y. Application filed October 17, 1893.

The invention has for its object to produce a device which will thoroughly ventilate the armatures of dynamos or motors by currents of air in order to carry off the heat generated by the passage through the coils of large currents of electricity.

523,164. Supply System for Electric Railways. Edward H. Johnson, New York, N. Y., and Robert Lundell, Brooklyn, N. Y. Application filed December 19, 1893.

The invention relates to improvements in that type of electric railways in which the current feeder supplying the propelling current is buried or insulated throughout the length of the entire route, and is provided with sectional trolley conductors located parallel thereto, each of the sectional conductors having means for automatically connecting it to the current main and disconnecting it therefrom as a car passes over them, the car being usually provided with one or more contacting brushes or trolleys which convey the current to and through the propelling motor, and to this end it is directed especially to improvements upon an invention disclosed in a prior application.

523,165. Supply System for Electric Railways. Edward H. Johnson, New York, N. Y., and Robert Lundell, Brooklyn, N. Y. Application filed January 16, 1894.

This invention relates to improvements in that type of electric railways in which the propelling current is taken from exposed sectional trolley conductors automatically connected, as the car proceeds over the route, to an insulated current main in direct circuit connection with a dynamo-electric machine, and to this end it is directed particularly to improvements upon an invention disclosed in a prior application filed by the inventors (No. 494,992).

523,166. Supply System for Electric Railways. Edward H. Johnson, New York, N. Y., and Robert Lundell, Brooklyn, N. Y. Application filed February 10, 1894.

This invention is similar in purpose for the greater part to the preceding patent issued the same inventors.

523,172. Electric Railway Crossing Insulator. Henry B. Nichols and Frederick H. Lincoln, Philadelphia, Pa. Application filed May 9, 1894.

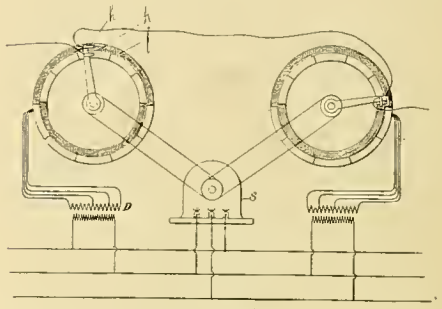
The principal objects of this invention are to provide a simple, durable, inexpensive and efficient crossing insulator for an overhead electric trolley system, and to provide an insulator for an overhead trolley system adapted to be included in cross or intersecting lines in such manner as to thoroughly insulate one line from the other; to reduce sparking to a minimum, and to maintain substantially unbroken circuits in the transit of the trolleys along the lines in contact with the device included in the circuits.

523,204. Incandescent Electric Lamp. William E. Forest, New York, N. Y. Application filed August 1, 1893.

In the incandescent lamp described there is had the combination of a globe provided with a conical neck, a perforated stopper fitted to the narrow portion of the conical neck, a perforated stopper fitted to the wider portion of the conical neck, a glass tube provided with leading-in wires inserted in the stoppers, and a body of plastic cement surrounding the glass tube and filling the space between the glass tube, the inner wall of the conical neck and the adjacent surfaces of the conical neck.

523,247. Magneto-electric Machine. Ernest Tilmann, New York, N. Y. Application filed November 22, 1893.

A magneto electric machine is described, which is intended for the purpose of supplying a current of high intensity to a miniature incandescent lamp, the devices being employed upon a bicycle, cab, or other vehicle.



NO. 522,988.

523,264. Material for Making Electric Light Filaments. Gustave A. Cannot, London, England. Application filed December 12, 1893.

In the manufacture of filaments according to this invention, peat fiber preferably thoroughly cleansed of impurities, is spun into a thin yarn which is carbonized in the ordinary way, and is then put in the lamps and further treated and finished in the usual manner in which carbon filaments are treated.

523,271. Conduit Electric Railway. John W. Eisenhuth, San Francisco, Cal. Application filed March 12, 1894.

The objects of the invention are to provide in a conduit electric railway a conduit in which the loss of the current from leakage will be reduced to the minimum; to so form the conduit that all dirt, water, etc., falling into it can be readily removed; to provide a conduit in which the positive and negative wires may be very near together without any danger of short-circuiting between them.

523,276. Telephone Transmitter. Theodore Grissinger, Mechanicsburg, Pa. Application filed May 24, 1894.

It is the object of this invention to obtain the necessary undulations of current through the action on the granulated variable resistance material of a plunger that is independent of the fixed electrodes, and at all times out of contact therewith, and to so arrange the plunger that it will be capable of effecting the required changes of position in the particles constituting the variable resistance medium.

523,278. Electric Rail Bond. James G. Hallas, Waterbury, Con. Application filed May 1, 1894.

The invention has for its object to provide a bond for the rails of the electric railroads which shall be inexpensive to produce, and which shall be so constructed as to expand and contract with the expansion and contraction of the rails, and which shall have sufficient spring quality to permit it to yield should the rails be unevenly laid or become loosened in use, and, furthermore, to prevent the metal of the bond from becoming crystalized from the continual pounding of the wheels of the cars.

523,284. Bonding Joints for Electric Railways. Andrew J. Johnston, Richmond, Va. Application filed May 5, 1894.

The main feature of this invention consists in providing additional electrical contact for the bond by means of flanged confining nuts which embrace the end of the bond, and which are screwed tight against the sides of the web of the rail, the rail having been previously faced off so as to insure a close fit.

523,305. Incandescent Electric Lamp. John E. Criggal, Springfield, Mass. Application filed June 11, 1894.

A mount for an incandescent electric lamp comprising a single tube of glass, the leading-in wires extending longitudinally through the tube, a vitrified substance embedded within the tube, and a body of rubber cement also contained in the tube are the features of a portion of this patent.

523,306. Electric Railway. Henry A. Doty, Janesville, Wis.

A conductor is provided which may be for the most part insulated, and which has at intervals projecting lugs which are uninsulated, as well as flexible contact shoes arranged to make a sliding contact with both sides of the lugs to the end that perfect contact may be made, sparking avoided and the current used with but little leakage. A trolley is also utilized which is adapted to be used with the conductor described, which may be applied to any kind of a car, which is adapted to run smoothly in the slot of a coudnit, and which has such freedom of lateral movement that it always retains its correct position without regard to the rocking of the car or the rounding of curves.

523,313. Electric Railway System. Rudolph M. Hunter, Philadelphia, Pa. Application filed March 4, 1889.

Among other advancements the invention contemplates improvements in combined railway and lighting circuits, and in which the conductors or circuits of an electric railway are combined with electric lights, either arc or incandescent, arranged in series or multiple arc, or both, in the working conductors or in the return circuit. The invention also contemplates providing an electric railway circuit with a short-circuiting device controlled by the current in the working conductors, whereby when all of the cars have run off the line the generator is short-circuited, cutting out the line by the closing of an automatic switch.

523,319. Electrical Conductor for Trolleys. John W. Eisenhuth, San Francisco, Cal. Application filed June 21, 1893.

The invention comprises an improved trolley wire for electric cars, etc., wherein the greater part of the current shall be carried in an insulated conductor, and only a small portion of the current, that required for immediate use, shall be exposed.

# Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, AUGUST 4, 1894. No. 5


MASSACHUSETTS INSTITUTE OF TECHNOLOGY. DEPARTMENT OF PHYSICS

## Storage Batteries for Lighting Apartment Houses in Chicago.

There can be no doubt of the growth in popularity which has accompanied the development of the storage battery for lighting purposes during the last few years in this country. Indeed, during the last twelve months an activity has been noticed in the entire storage battery field, which will soon place this country upon an equal footing with Europe, where it is generally acknowledged battery practice is considerably in advance of this country. The application of electric lighting in flat buildings and apartment houses possesses many interesting features and demands of the electrical engineer the solution of problems more difficult than those in other lighting work. The limitations of space and the necessity for a thoroughly reliable and constant service, as well as the economic features, which must in many cases be considered of prime importance, unite to make this class of electrical work interesting as well as difficult. One of the latest installations of this sort in Chicago and one which may be taken as a model plant of its kind in many respects, is that in the Tamalpais and Kent apartment houses on Forty-third street and Calumet avenue. These buildings stand upon diagonally opposite corners and belong to the same estate. Great care was shown by the agent of the estate, Otto T. Langbein, in selecting the apparatus, and every provision was made for efficient service. The dynamo room, shown in Fig. 1, is 10½ by 22 feet, and contains two Waddell-Entz dynamos, one of 60 kilowatt and the other of 30 kilowatt capacity, directly connected to 80 and 50 horse power Ideal engines respectively, two switchboards, a board containing temperature indicating apparatus, steam pressure gauges, clocks, etc., a "booster" for the storage battery plant, and a two horse power Jenney motor for driving a 30 inch ventilating fan. It will thus be seen that the difficulty of lack of space has been overcome satisfactorily. The machinery in the room has been carefully arranged and brass railings serve to keep at a proper distance visitors to the plant. The buildings are wired upon the two wire system and circuits are led from the Tamalpais, in the basement of which the plant is located, in an underground conduit which also contains steam pipes for heating the flats, to a main distribution box in the Kent. From this point current is distributed to three secondary distribution boxes, the service of course being controlled from the main switchboard. Each building is wired for 500 incandescent lights, and provisions are made for 16 2000 candle-power arc lamps manufactured by the General Incandescent Arc Light company of New York. The wiring of both buildings was done by George Warren Furbeck.

In Fig. 2 is shown the main switchboard, eight by nine feet, which is of particularly pleasing appearance. It is constructed of Italian marble with bus bars and connections on the back and is furnished with ornamental lighting fixtures. It contains two Anthony ammeters, a voltmeter of the same make, a ground detector, a multiple switch for the voltmeter so that it reads the pressure of both dynamos and also that of the storage batteries, two three-way switches, one controlling "Jumbo" and the other the "Dude," as the wording upon the switchboard indicates the dynamos have been familiarly christened, two rheostats and 12 double-pole switches for the house circuits.

The advantages of a storage battery plant to be utilized for carrying the greater portion of the day load and the all-night load as well were taken into consideration, and a plant of 56 400 ampere hour cells, manufactured by the Pumpelly-Sorley Storage Battery company, Chicago, was installed, with provision being made in the size of the containing jars for an increase in the capacity of the cells to 600 ampere hours. The plant was installed under the direction of W. S. Arnold, manager of the company. The cells, as shown in Fig. 3, which is general view of

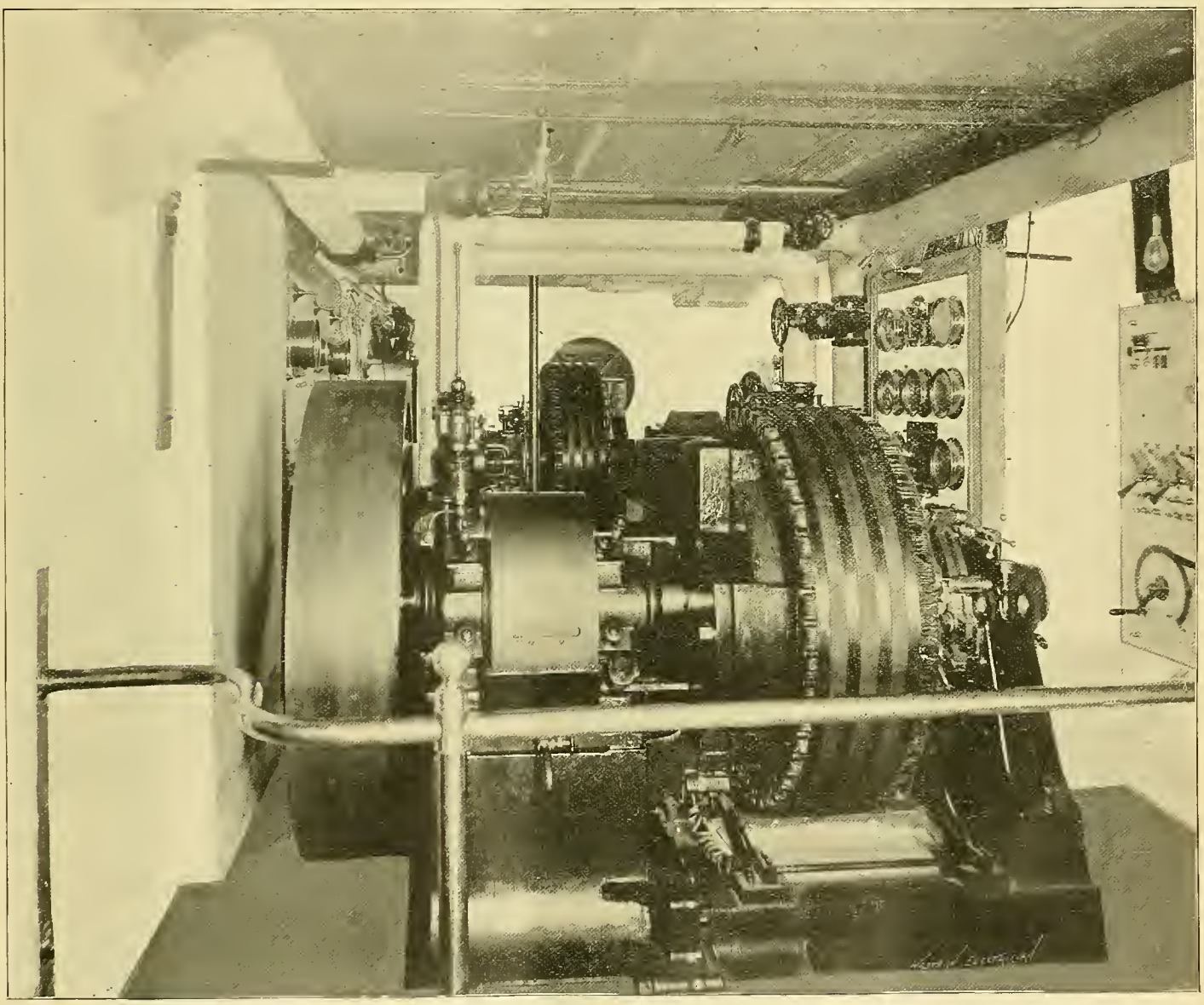


FIG. 1. STORAGE BATTERIES FOR LIGHTING APARTMENT HOUSES IN CHICAGO.

the battery room, are supported upon hardwood racks and rest upon porcelain insulators, the elements being held in lead lined hardwood cases. The Pumpelly-Sorley storage battery was fully described and illustrated in the WESTERN ELECTRICIAN of December 2, 1893, and a record given of some of the tests made upon it. One of the distinguishing features of this cell is the mechanical construction of the plate, composed as it is of one integral piece of rolled lead which is punched out by machinery from a solid sheet of lead. The plate is placed in a die and slotted by means of gang saws which pass through it. The plate is now composed of a series of small horizontal bars extending from rib to rib, and is so constructed that no soldered joints are used. It is then put through an electrolytic process by means of which the interstices are completely filled with peroxide of lead formed from the plate itself, there by doing away with the necessity of applying a paste or any active material to the plate. After the plates are formed they are assembled and a sheet of absorbent vegetable fiber placed between each positive and negative plate to prevent short circuiting.

The plant is installed in a room 12 by 40 feet, and its operation is as follows: An engine and dynamo start at 5:30 P. M. and furnish current for the incandescent and arc lamps in the buildings and stores on the ground floor, the load gradually increasing as the lights are turned on at night. The capacity of the dynamo being somewhat greater than is necessary to supply the customary demand for light at this time, a portion of the current is used to charge the cells; this amount being greater during the forepart of the evening and during the latter part of the run. The charging current is cut down from 7 until 10 o'clock, when almost the entire capacity of the generator is used to supply the lights in the buildings, It will be seen that the engine and dynamo operate at almost constant load from the beginning of the run to the ending, thus securing maximum economy. The engines are shut down at 11:30 P. M. when the load becomes light. The storage batteries are then switched onto the main bus bars and carry the load of lights and ventilating fan until 5:30 P. M., a service of about 18 hours. The plant is so wired that the cells can be charged from either dynamo without the "booster" or can be charged from the larger dynamo with it as follows: A portion of the current generated by the large dynamo is taken from the bus bars of the main switchboard and led by means of proper wiring and switches to the cells set up in series. The armature of the "booster" is inserted in series with the battery charging circuit and revolves in a magnetic field excited from the bus bars of the main switchboard, the function of the "booster" being to raise the voltage of whatever current enters the cells from 110 volts at the bus bars to whatever voltage is necessary to overcome the resistance of the cells and force the proper amount of current into them. The "booster" raises the voltage from 10 to 40 volts, forcing as high as 50 amperes into the cells, depending upon the adjustment of the "booster" rheostat. The lever for this rheostat is shown in Fig. 4 in the lower left hand corner of the battery board, and is made larger than necessary to harmonize and be symmetrical with the battery step-up switch in the other lower corner. This board is equipped with special apparatus manufactured by Cutler & Hammer, Chicago, and contains overcharge and overdischarge switches, an ammeter, an automatic circuit breaker, an eight point step-up switch constructed with special reference being made to secure freedom from arcing, a double throw single-pole switch, a "booster" rheostat and four snap switches provided with fuses.

Two horizontal tubular boilers of 75 horse power capacity each provided with a combustion damper regulators, supply the steam for the engines and heat the two buildings. Provision has been made in both electrical and steam equipment to give service to another building to be erected in the neighborhood. As may be judged from the illustrations, no pains have been spared to make this plant complete in every detail, and it is evident that the peculiar conditions of economical and constant electric lighting of flat buildings have been given much thought. The usefulness of storage batteries in this capacity will undoubtedly be more generally appreciated, as plants such as this one illustrate the practicability and advantages of their use.

## American Electro-therapeutic Association.

The fourth annual meeting of the American Electro-therapeutic association will be held at New York on September 25th, 26th and 27th. The meetings will be held in the New York Academy of Medicine. Dr. W. J. Herdman, of the University of Michigan, Ann Arbor, Mich., will open the proceedings with an address. The list of papers to be presented contains several contributions from eminent members of the medical and electrical fraternity.

## Corrosion of Pipes in Boston by Electrolysis.

During the year 1892 a number of leaks in lead service-pipes in Boston were found which it was presumed, were caused by electrolytic action due to underground currents of electricity induced by the street railway trolley system. The pipes were decomposed on the exterior surface and presented a pitted appearance. Most of the cases were discovered in the immediate vicinity of the power station of the West End Railroad company. An investigation was begun into the causes and extent of the difficulty, with the view of taking the necessary measures to preserve the pipes, both lead and iron, from further injury. This investigation was placed in the hands of Stone & Webster, electrical engineers, and the result of their preliminary study as shown in the report appended herewith indicates that decomposition of the pipes is going on, but that, generally, it may not be apparent for some years.

The points considered in this report are as follows: First, the evidence showing injury by corrosive electrolysis to undergrond iron and lead piping for water, gas and telephone cables in Boston and elsewhere; second, the nature of this injury to pipes as developed by experimental tests in the laboratory; third, the existence of the necessary conditions, electric and otherwise in the soil of Boston, to produce electrolysis in pipes laid therein; fourth, the proof that these electric conditions are due to the return currents by way of the earth, arising from the electric service of the West End Street Railway company.

From these we shall show that the inference that serious corrosion may be proceeding from this cause is almost unavoidable, while, however, distinctly pointing out that the evidence is still insufficient for decisive judgment. While we are not yet prepared to suggest a practicable and complete remedy, we shall point out methods by which the trouble has been somewhat lessened in certain instances.

FIG. 3. STORAGE BATTERIES FOR LIGHTING APARTMENT HOUSES IN CHICAGO.

The action of electrolysis is to corrode the pipes, chiefly at the surfaces where the electric current leaves them. This corrosion is not uniformly distributed over the surface, but is quite irregular, usually producing deep pits. Its tendency is, therefore, to accelerate the natural rate of decay of the pipes, the rate of corrosion being greater as the current flowing out of the pipe is greater. The evidence of injury to water and gas mains by electric action would, therefore, naturally be expected to take two forms: One, the very premature giving out of pipes in localities where the conditions were such that especially large currents flowed out from the surface of the pipes; the other, the increase of rate of renewals and repairs in the entire system, so far as exposed to the electric currents. Evidence of the first sort would presumably be the earliest to develop itself, and we shall quote some instances. Evidence of the second sort would appear only in the course of years, and the evil might have assumed serious proportions before this class of evidence became convincing. We have been able to secure very little such evidence. It should be clearly apprehended that the injury to the pipes, if going on at all, is of a very insidious character, consisting, as stated, merely in an acceleration of the natural decay of the pipes. This acceleration might be seriously large and yet not become apparent for a term of some years, when the trouble would suddenly begin to assume very large proportions. The absence of extensive direct evidence of destruction must not, therefore, be interpreted as proving the absence of the action. The amount of direct evidence, although not yet large, is sufficiently disquieting.

Of actual giving out of water pipes in Boston, apparently through electrolysis, the only instances which we are able to cite are those of lead service pipes in the vicinity of the power station of the West End Street Railway company on Albany street. At the time that these pipes were discovered, the subject was not under careful investigation, and the reasonable supposition that electric currents played a considerable part in their destruction was not put to test by critical inspection. Of the destruction of lead piping in general by electrolytic action underground, we have abundant and indisputable evidence in the corrosion of the lead sheaths of telephone cables. In one case, the sheath of a new cable was destroyed within six weeks of laying. The amount of the injury, its nature, and the methods successfully adopted for its partial removal, show conclusively that it was due to the electric currents traversing and escaping from the lead covering on their way between the electric cars and the power station of the West End Street Railway company, in the same way that they presumably do from water pipes. From several cities other than Boston, owing possibly to more favorable conditions for the development of trouble, injury of a serious nature has been reported respecting water and gas mains. We have information, reliable in character, showing electrolytic injury of water pipes in Peoria, Ill., and Cambridge, Mass., and of iron mains in Norwalk, Conn., the trouble being serious in all cases.

In order to get an idea of the probable character of the electrolytic action upon the water pipes and the rapidity with which it might be taking place, a number of tests were made at our laboratory upon commercial specimens of pipe, under conditions similar to those to which the city piping is exposed. The pipes were grouped in pairs, as shown by the table of pipe tests, and each pair in a separate box of moist sand sprinkled with a small quantity of common salt. In this respect they were practically under the conditions of pipes buried in the streets, since the moist earth usually contains common salt and other salts either from the tide water or from surface drainage. Measured currents of electricity at constant pressure were then caused to flow for noted times from one pipe to the other of a pair. Thus one pipe would show the action when the current flowed out of the pipe into the earth (that is, when the pipe was electrically positive with respect to the earth around it); the other would show the effects when the current flowed from the earth into the pipe (that is, when the pipe was negative relatively to its surroundings). The common salt in the water by its electrolysis yields chlorine at the surface where the current of electricity leaves the pipe. This corrodes the pipe rapidly. At the surface where the current enters the pipe the product formed by the electrolysis has but little corrosive action. This well-known fact was borne out by these experiments, which developed, moreover, a point of great practical importance, namely, that the corrosion took place largely in a localized manner; that is, the pipes became deeply pitted in spots instead of corroding uniformly over the surface.

Although the difference of potential between every pair was the same, the currents were of various magnitudes corresponding to the degree of moisture and quantity of salt in solution. Consequently, this must be taken into consideration, in comparing the effect of electrolysis on pipes in different boxes; for with pipes of the same material the losses are directly proportional to the magnitudes of the currents. After reweighing at the end of 100 hours, the tests were continued for fifty hours more on all the specimens except Nos. 13 and 14. The positive pipes were all badly pitted, so that the amount lost, as determined by weighing before and after the run, is not a true measure of their deterioration.

TARRED WROUGHT-PIPE NO. 13.

| | |
|---|---|
| Length | 1 foot. |
| Diameter | 1 inch. |
| Original weight | 694.7 grams. |
| Loss of weight after 100 hours | 53.2 " |
| Average current | 0.739 amp. |
| Average voltage | 12.96 volts. |
| Weight of iron turned off in ½ length | 191.9 grams. |
| Weight of iron pipe, equivalent to pipe in present condition | 257.7 grams |
| Present value in per cent. of original | 37 per cent. |

To make this more evident pipe No. 13, which had lost but 7.6 per cent. in weight, was turned down for half its length to the bottom of the deepest pit, and the loss in

weight was then found to be, for the whole pipe, 63 per cent. This shows, of course, that owing to the formation of pits the corrosion has gone in spots to about eight times the depth that it would have gone if it had been uniform over the surface. This is a true measure of the electrolytic action, for the strength of a pipe is determined by the strength at its thinnest part, which leaves the pipe but 37 per cent. of its original value.

After running 150 hours, four other iron pipes, Nos. 1, 5, 9 and 11 were similarly treated, and the results are tabulated below. The positive lead pipes were so deeply pitted that it was impossible to turn them down. They showed even more marked deterioration, however, than the wrought iron pipes.

TABLE SHOWING TRUE EXTENT OF DETERIORATION CAUSED BY ELECTROLYSIS.

| Number of pipe | 1 | 5 | 9 | 11 |
|---|---|---|---|---|
| Length | 1 ft. | 1 ft. | 1 ft. | 1 ft. |
| Diameter | 2 in. | 1 in. | 1 in | 1 in. |
| Original weight in grams | 1565.3 | 693.0 | 638 0 | 695.0 |
| Loss of weight in 150 hours | 39 7 | 172.8 | 202.2 | 129 2 |
| Average current | 0.253 | 1.420 | 1.472 | 0.946 |
| Average voltage | 12.37 | | | |
| Weight of pipe equivalent to pipe in present condition | 850.6 | 169.6 | 199.6 | 161.2 |
| Present value in per cent. of original | 54.3 | 24.5 | 31.3 | 23.2 |

In these tests data have been accumulated which may prove of further value later in a discussion of the relative merits of different kinds of piping, but which we are not now prepared to enter upon. In the experiments, in order to save time, it was necessary to use currents of electricity larger than could be expected to occur except under unusual conditions in practice. This, however, does not affect the general character of the electrolytic action, but only its rate, the amount of electrolysis being proportional to the current. This corrosion and disintegration of the sheaths of the telephone cables by electrolysis underground was of the same general character as that in the lead pipes tested in the laboratory.

If we could ascertain by direct means whether currents of electricity were flowing from the earth into the pipes or from the pipes to earth, how large these currents were, and how they were distributed over the pipe surface, we should then have a direct means of estimating the injury done to the pipes; but these three points are from the nature of the case very difficult, if not impossible, of even rough determination. It is essential, therefore, to proceed indirectly by showing that the underground electrical conditions in the city are such as either to render destructive electrolysis likely, or render it unlikely. We have done so as follows: By extended tests we have shown that the distribution of electrical pressure in the earth in Boston is such that there must be a continual and at times strong flow of electricity through the earth from nearly all parts of the city, toward the West End power station on Albany street.

Inasmuch as iron water and gas mains are imbedded broadcast in the soil, and are relatively much better conductors than the soil, bulk for bulk, a portion of these currents must traverse the pipes; and since there is no metallic connection between the pipes and the railway returns, the current must enter and leave the pipes by way of the earth. Whenever the current thus enters or leaves a pipe it is accompanied by electrolysis at that point, the amount of electrolysis being proportional to the current. This produces corrosion, but chiefly where the current leaves the pipe. Admitting then the conclusion just drawn that currents must enter and leave the pipes, and since this process is nearly continuous throughout the day, the inference is unavoidable that corrosion is continually going on, and in the same measure as the current. This inference is confirmed by multiplied tests, which show that the piping is almost everywhere at a potential difference from the earth around it, and from the nearest railway tracks. Under such conditions currents must be flowing either to or from the pipes. These differences, are, moreover, not constant, but subject to continual momentary fluctuation, which add to the certainty of the flow of currents.

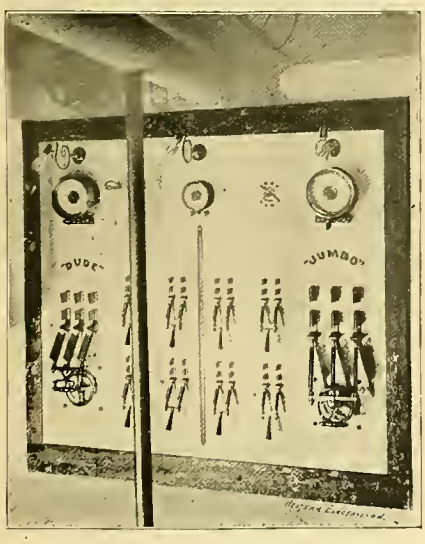



FIG. 2. STORAGE BATTERIES FOR LIGHTING APARTMENT HOUSES IN CHICAGO.

The demonstration of the continual flow of currents through the earth to the power station was made by measuring the difference between the electrical pressure in the water piping at a point near the station and at other distributed points. These outlying points showed always higher pressures than the one near the station. The difference amounted in no case to more than 15 volts in 4,000 feet. Similar measurements were made between the outlying points themselves. It is evident that by taking a sufficient number of points and of pressure observations between them, an equipotential map—that is, a map, showing lines of equal pressure difference relatively to the power station might be drawn; but while such a map would possess some value, we have not yet thought ourselves justified in incurring the expense of running the necessary number of overhead lines in the city.

It is, perhaps, not superfluous to add that the substances which give the soil its conductivity are chiefly the various salts which are in solution in the water of the soil. Earth itself, when perfectly dry, is a very poor conductor; water when pure is also a very poor conductor. Moist air is usually

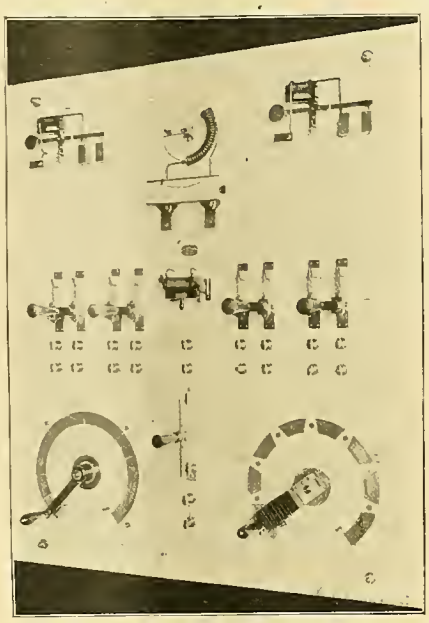


FIG. 4. STORAGE BATTERIES FOR LIGHTING APARTMENT HOUSES IN CHICAGO.

a comparatively good conductor, not, however, because of the conductivity of the water itself, but because the water holds in solution common salt and other salts which make it a conductor, these being derived either from the soil, from surface drainage or from the sea, much of the soil beneath Boston being moistened by tide water. There are, therefore, present in the soil of Boston, not only the electric current necessary to produce electrolysis, but the materials which will upon electrolysis produce corrosion of iron and lead.

The measurements of difference of potential already mentioned between various points afford convincing proof that these pressures are due almost exclusively to the return currents of the West End Street Railway company. For not only are the pressures found to be distributed about the power station in the way which would be anticipated, but they show fluctuations from hour to hour, and even minute to minute throughout the day, which when plotted as curves, show the characteristic form of the power load at the station, being nearly zero in the early morning hours, and having four maxima; namely, at about 8 A. M., 6, 8 and 11 P. M. This point is very clearly illustrated by tests made on January 3 and 4, 1894, to show the difference of potential between the waterpipes at different points in the city. By means of rubber-covered copper wires the waterpipes at Foster's wharf and Summer street were connected with the waterpipes at the corner of Harrison avenue and Bristol street, near the power station of the West End Street Railway company. Continuous readings of the difference in potentials were taken for 24 hours, and the results show admirably the periodic fluctuations corresponding to the amount of travel on the railroad. If any evidence of the source of these currents and pressures were necessary, this would be incontestible.

It seems from the preceeding discussion that the direct evidence is good, although not yet ample; that injury has been wrought upon iron and lead pipes buried in the earth, this injury being the direct result of corrosion arising from the passage of the return currents of an electric street-railway into or out of the pipes. It seems further to be almost incontestably shown that the underground conditions in Boston are such that electric currents, presumably of considerable magnitude, pass into and out of the pipes by way of the earth, and with the unavoidable accompaniment of electrolysis and corrosion. It remains to be shown whether this corrosion is, or is not under existing conditions, a serious factor in lessening the life of the piping system as a whole or any part of it in particular. Upon this most important subject we feel that the points previously made in this report would certainly not warrant a hopeful view. They would rather incline one toward the opinion that serious corrosion may be now proceeding; but we must strongly call attention to the fact that it has been impossible, thus far, to acquire sufficient reliable information to warrant a decision. The matter is under further investigation.

As to remedy it is clear, of course, that were the return railway circuit to be confined to channels provided for it, the trouble would cease. This it is impossible to do with a railway system in which the cars give up their return current to the uninsulated rails as now. However good the conductivity of the copper return lines provided, the current will divide between them and the earth, the fraction going back by earth being to that going back by the copper lines as the earth conductivity is to that of the lines. Now, the earth conductivity is at least fairly good, so that the amount of copper required in returns becomes enormous to reduce the earth currents to small amounts. Railway systems which do not ground the return have not proved successful for various reasons.

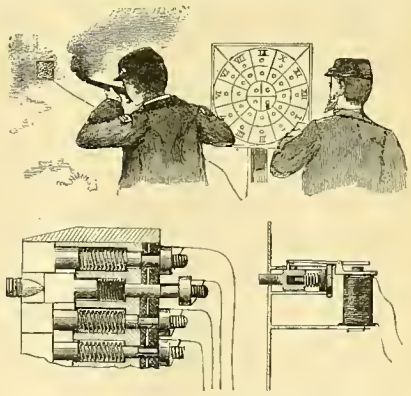
To remove the difficulty with telephone cables, the New England Telephone & Telegraph company has laid a special copper return along to the affected part of the cable, and thence by a heavy overhead line back to the power-house. This, together with the practice by the West End Street Railway company of making the trolley wire positive, has proved largely successful. It is feasible because the number of these cases to be dealt with is comparatively small, so that the expense is not intolerable. A similar suggestion respecting certain portions of the watermain system was offered by us in February, 1893. The larger and better distributed such a system of special copper return from the waterpipes is, the less danger from electrolysis; but the greater outlay for copper involved is prohibitive beyond a certain limit. Whether within this limit the electrolysis can be reduced to an unimportant amount is by means yet demonstrated. The data is still so incomplete as not to warrant a positive inference.

## Steering by Electricity.

A French paper describes a device invented by M. Bersier for operating the rudder of vessels without a man at the wheel. In this device the standard compass is used and a current from a Ruhmkorff coil is passed from the pivot of the needle to the north pole extremity, from which sparks 3 millimeters in length pass to one of two semi-circular pieces of aluminum insulated from each other, the gap between them being set to the desired sailing direction. When the spark passes to one of these, the current, by means of a relay, starts a motor in one direction, which in turn operates the rudder, while if the spark passes to the other piece, it moves the rudder in the other direction. The apparatus has been in use for two months on the steamer Neptune, and is said to operate very successfully. An additional device is mentioned, in which these sparks pass through a strip of paper, by means of which the record is automatically kept. It is claimed that the errors inseparable from the present method of steering—averaging one to two degrees—will be corrected by the electrical steering system.

## Electrical Indicator for Target Practice.

Among some of the recent applications of electricity that of indicating the results of a shot fired at a target located at some distance from the gun is particularly interesting. The accompanying illustration represents the arrangement by means of which an indicator dial at the shooting stand is so connected electrically with the target that the exact effect of each shot may be at once seen on the dial, without the necessity of inspecting the target. The idea is that of Charles Schifferdecker of Fort Assinaboine, Mont. The target is arranged in a holding frame, and is divided into radial sections, the bull's eye consisting of four sections. These sections are filled with push buttons, which form the face of the target, and have rearwardly projecting bolts, each encircled by a spiral spring as shown in the picture. In the rear end of each bolt is a conducting plate, from which a wire leads to one pole of a battery, including in its circuit one of the magnets of the indicator dial, the different wires from the target being preferably united to form a cable. The indicator dial, located near the shooting stand, is divided into sections corresponding to those of the target,



ELECTRICAL INDICATOR FOR TARGET PRACTICE.

and numbered consecutively from I to XII like the dial of a clock, by which the score of a shooter may be readily reckoned. Behind each section of the dial is a tube with a spring-pressed sliding plunger, which is also shown in the illustration, and a pointer which protrudes from the face of the dial when the plunger is released. The plunger with its pointer is normally held in retracted position by a catch on an armature lever, but when the magnet is energized by the closing of the circuit, which occurs when one of the push buttons of the target is forced backward by the impact of a bullet, the plunger is released and slides forward so as to display the pointer, showing in which section of the target the bullet has struck. If desired, an electric bell may be included in the circuit, so as to ring at the same time the pointer is displayed. The illustration is reproduced from the *Scientific American*.

## Some Facts About Polyphase Motors.[1]

By Dr. Louis Bell.

In connection with the long distance transmission of power, most engineers will, I think, agree with me in the position that alternating current motors of some kind, and of alternating currents preferably the polyphase variety, are almost a necessity. We have been forced to their use by the exigencies of long distance service, which compel either the total abandonment of continuous current or its use under very embarrassing conditions.

At present, appearances indicate that not only will the polyphase motor displace direct current apparatus for most

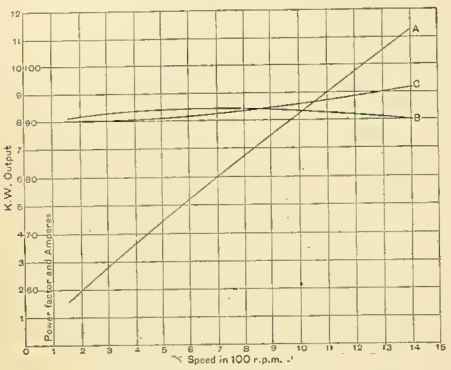



FIG. 1. SOME FACTS ABOUT POLYPHASE MOTORS.

long-distance transmission plants, but will prove a formidable competitor in all applications of motors to industrial purposes and this, although the polyphase apparatus is the growth of only a few years, while the direct current motor is the outcome of more than a decade of experience.

We may then, in instituting a comparison between polyphase and direct current motors, consider the various properties which a good motor of any kind must necessarily have. Mechanically speaking, we would all agree that it should be simple in construction, strong, not liable to frequent or considerable repairs, convenient in form and not excessive in weight. As regards its properties, it should be generally run cool, stand overloading without serious danger, run at a nearly constant speed, or be capable of considerable variation in speed if necessary. It should be capable for certain uses of sudden and violent exertion, and of easily changing its direction of rotation. In a purely electrical way, it should be simple, efficient both at high and low loads, and should not take excessive amounts of current either in starting or in running.

This represents a difficult list of conditions to fulfil with any one motor, but I believe they can be met better by polyphase than by direct current machines. A direct current motor, for instance, of a given construction and reasonable weight cannot both run at a constant speed independent of load in a particular case and at the same time be capable of running at a wide variety of other speeds. It usually will not stand considerable overloads without sparking, and at the same time give a fair efficiency at low loads. And so one might go on piling up difficulties. The polyphase motor, too, cannot meet all these conditions with equal success, but examining them one by one, you will find that on the whole we can obtain very excellent results.

Taking up seriatim the desirable properties which I have enumerated, and applying them to polyphase motors, we find as regards the first count that their construction is singularly free from complexity. They consist in general of two concentric masses of laminations forming respectively the field magnet and armature. The armature is assembled on its shaft much as in direct current machinery, while the field laminations are held together by a clamping spider of very simple construction. The bearings are supported either on end spiders fitted to the field spiders by lathe work only, or on pillow blocks of the ordinary kind. Commutator and commutator connections there are none, nor should there be collecting rings except in rare instances. The armature need be exposed only to low voltages, and should preferably be wound with a comparatively small number of rather massive conductors, united at the ends either by a single plate or by very simple connectors, the latter form being preferable. The field winding is usually in a greater number of coils than is a direct current field winding, but each coil has a comparatively small number of convolutions, making the total winding by no means complicated.

In lieu of the starting rheostat of the direct current motor, we have a starting resistance which should preferably be placed within the armature, and consists of a few zig-zags of metal united at one end and connected at the other to three or more contact pieces. A solid collar short-circuiting these contacts and a forked lever to move the collar completes the equipment, as I am accustomed to employ it. Its most noticeable feature is that the revolving armature, the most troublesome and delicate part of a direct current machine, is free from complication, and that it is almost as solid as if it were a solid mass of metal, and scarcely more liable to injury.

This very obvious simplicity of construction and mechanical strength is strong evidence of unusual freedom from repairs, and as a result of experience I have found that the induction motor is singularly free from liability to accidents of every kind. I have never succeeded even by the severest kind of experimental work in burning out a field coil or doing any serious injury whatever to a motor, although I have kept some of them on static torque tests in rapid succession for hours at a time, and have held them at rest and poured current through them until the leads burned off, the motor still remaining undamaged. If there is a test of extraordinary severity that I have not applied to induction motors, I have yet to learn of it. These properties are invaluable in commercial work, inasmuch as they practically remove the danger of crippling the motor even under exceptionally unfavorable conditions.

As regards the convenience of the form of polyphase induction motors, I think an inspection of any of the types which have been brought out will render argument unnecessary.

The magnetic necessities of the case have led all makers of such apparatus in this country and elsewhere to adopt a species of barrel shape as the general outline of the motor, modified only in the proportions of diameter to length and in the adoption of one form or another of bearing. The tendency of this construction is to bring the center of gravity of the machine very low, thus insuring unusual stability and freedom from general vibration. This form, too, enables one to place the motor in almost any position which is convenient in applying it, upside down, as a side bracket, and the like.

The largest installation of induction motors in the world, just put in operation in Columbia, S. C., aggregating over 1,200 horse power, is composed of inverted motors with their bases bolted to the ceiling timbers of the rooms.

As regards weight the abolition of any sparking limit to the output, and the excellent magnetic materials used, might naturally be supposed to lead to motors of unusually light weight, and such is in fact the case. Sixty to seventy pounds per horse power in motors of moderate size is a figure easily reached without any sacrifice of efficiency, and if occasion requires these limits can be passed with great facility, 25 to 30 pounds of material per horse power being quite attainable in large units while still retaining satisfactory general properties. I must say, however, that for most uses I do not consider extreme lightness either necessary or desirable, although it is important to be able to secure it if necessary. So much for the mechanical character of induction motors.

Electrically speaking, the case is just as favorable. Unless forced to a very large output per pound of weight, an induction motor will run quite cool, at a heating limit in fact below that of most direct current machines of similar weight and output. This advantage is mainly due to the very substantial character of winding which can be conveniently employed and to the fact that the winding is distributed so that the losses in the copper are not localized while the laminated character of the structure facilitates thorough ventilation. This freedom from excessive heating indicates that the polyphase motor can stand considerable overloading

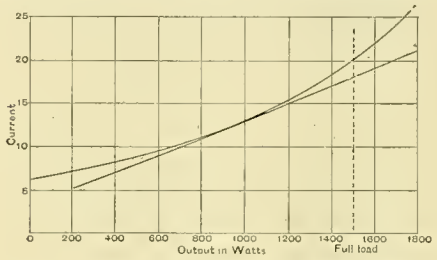



FIG. 3. SOME FACTS ABOUT POLYPHASE MOTORS.

without any serious results and experience has shown this to be the case. The worst that can really happen is that the motor may fall out of synchronism when the load is sufficiently great, thereby blowing the fuses in the primary line.

As sparking is obviated in this type of machine it can readily be rated at such output as will give a proper limit of heating, and this output will in most cases allow from 30 to 60 per cent. of overloading before the machine will drop out of step. A wider range than this can be obtained if desirable, but it is generally not.

The limit of possible overloading fixes in a general way the possible static torque that can be obtained from a given machine, and this is apparently purely a matter of convenience in design, anything that can reasonably be required being quite attainable. There is no special difficulty in arranging polyphase motors for a starting torque four or five times the running torque, although this would be unnecessary except for severe hoisting and tramway work. At running torque the starting current taken may be no greater than the running current. From this it will readily be seen that a properly planned polyphase motor is easily of very great and violent exertions in a case of necessity. It will even endure complete reversal under full load within 10 or 15 seconds on motors of ordinary sizes, this time being sufficient for the machine to pass from full load in one direction to full load and speed in the other direction. This reversal is, as is well known, accomplished simply by reversing any two of the primary wires, the effect being to rotate the field in the opposite direction from the armature, thus causing an enormous rate of cutting lines of force and consequently immense effort, causing the motor to stop and reverse.

### SPEED VARIATION IN POLYPHASE MOTORS.

This subject has been for the most part in a rather hazy condition up to the present time. The induction motor has been generally known as non-synchronous, and such indeed it is. The name, however, has been frequently used in ignorance of the fact that an induction motor always tends toward synchronous running.

Under ordinary conditions the polyphase induction motor can be made to run at nearly constant speed independent of load, resembling in this respect a well designed shunt motor. A variation from no load to full load of 5 to 6 per cent. in speed would represent ordinary good practice, either in a shunt motor or a polyphase one, this limit being exceeded only in small motors or types which may be regarded as special. It is by no means difficult, however, so to design a polyphase motor that the speed shall possess very remarkable uniformity. This condition has been valuable in the Columbia plant previously alluded to. In this case tests of 17 motors showed a maximum variation in speed, from an output of 75 horse power to friction load of the motor, of only 2.2 per cent., individual motors showing slighter variations down to 1½ per cent.

The task of these particular motors is driving a cotton mill, hence the necessity for uniform speed. And this uniformity in speed is not greatly affected by variations in voltage, which would be quite sufficient to cause considerable speed variation in a shunt wound motor; in fact, the induction motor is remarkably insensitive to moderate variations in voltage, unless it is heavily loaded.

This uniformity in speed has frequently been urged as an objection to the induction motor, barring its employment in cases where speed variation is necessary. This point is not well taken.

The induction motor can not be made successfully to run at reduced speed by varying the primary voltage. Under these circumstances the output of the machine falls off somewhat more rapidly than the square of the voltage, so that only trifling speed variations are possible. It is a fact, not generally known, however, that the speed of a polyphase motor can be varied with the same facility and within the same wide range as is possible in the case of a series wound continuous current machine, such as a railway motor This is accomplished in the induction motor by a rheostat in the secondary circuit, just as it is accomplished in the series motor by a rheostat in the main circuit. Thus equipped the two machines behave almost exactly alike. The speed at constant torque can be made to vary from full speed down to almost no speed, thus simulating the action of the series motor in the closest possible fashion. At any given speed an increase or decrease of the torque will decrease or increase the speed substantially alike in both classes of motors. In both, too, the efficiency is initially similar and falls off in practically the same ratio. A non-inductive resistance is necessary in case of the polyphase motor, an inductive one throwing the armature current so far out of phase as to interfere with the proper action of the motor.

Fig. 1 gives an excellent idea of the behavior of a polyphase motor with resistance in the secondary circuit. Curve *A* shows the speed and output of a certain motor under these circumstances. It was a four-pole machine operated at 50 cycles per second and the initial speed was reduced to 1,400 by the resistance of the leads reaching across the room to the rheostat composed of loops of manganin strip which would be systemically varied. It will be seen that the word curve is almost a misnomer, the ratio between the speed and output at constant torque being almost a linear function, even when the speed fell to as low as 150 revolutions per minute. It was not carried lower than this only because of lack of adaptability in the rheostat. No series motor could show a more satisfactory result. Curve *B* shows the power factor under these varying conditions. It is high at all loads and speeds, varying slightly with a maximum at about half speed. Curve *C* shows the variation in current. This, as can be seen, is almost constant, falling off slightly at the lower speeds, the voltage being uniform throughout the test.

Speed variation by this method is not as efficient as might be wished, but still compares favorable with that obtained in a series motor with rheostatic control. Some modified methods of control promising a somewhat better efficiency have been suggested, but it seems probable that in the net result we shall find that continuous current and polyphase motors are about on a par in this respect. It should be noted that in continuous current motors speed variation by weakening the field is only practicable within a very limited range and requiries an abnormally heavy motor. I think that with a similar change in design the polyphase motor could be made to operate nearly as well by change in its field strength. An efficient speed variation through a very wide range is attainable in either class of machine only by extraordinary means, as an elaborate combination of direct current machines, or frequently changing devices in the

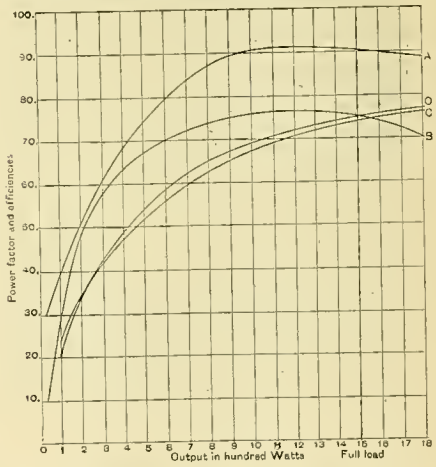



FIG. 2. SOME FACTS ABOUT POLYPHASE MOTORS.

polyphase machines. From what has been said it will be apparent that the polyphase motor is perfectly capable of a complete control of speed on the same terms generally obtained with continuous current motors.

### COMPARISON OF A POLYPHASE AND CONTINUOUS MOTOR.

Fig. 2 gives a striking comparison between the properties of the two classes of machines under consideration.

The polyphase motor selected for comparison is of 2 horse power output, representing the average small motor to be found in central station practice. This particular size weighs 218 pounds complete, and runs at a speed of about

1. Read before the American Institute of Electrical Engineers, Philadelphia, May 18, 1894.

1,400 revolutions per minute on 50 cycles, loaded. It is relatively neither better nor worse than polyphase motors of other sizes, as may be seen by reference to the curves in my previous paper on this general topic. The power factor in this case rises quite sharply, reaching 86 per cent. at half load, and through most of the working range of the motor remains at or near 90 per cent., nearly 91 per cent. as a maximum. The efficiency has its maximum a little under full load of the motor and reaches nearly 77 per cent., being 75 per cent. at full load. Both power factor and efficiency hold high values from half load up, and do not fall off seriously until some distance below half load.

Contrast with curves *A* and *B* belonging to the polyphase motor, curves *C* and *D*; the former is the efficiency curve of a 2 horse power 500 volt motor of one of the well-known American makes, and curve *D* is a similar curve for 2 horse power 110 volt motor of European manufacture. These are not selected curves, but were the two most available. Both these curves, *C* and *D*, show remarkable similarity. Neither of the motors sparked seriously at full load, the load limit being set rather by the heating. Both curves rise slowly and attain their maximum values at some point beyond the available load of the machine. At full load the efficiency is substantially the same as that of the triphase motor. At low loads it is noticeably worse. I think *C* and *D* are fair average machines. In tests of a wide variety of motors, some higher and lower efficiencies would be found. Such, too, would be the case in testing a variety of polyphase motors. In fact, the mate of the triphase motor shown, sent through the factory at the same time, showed about 1½ per cent. higher efficiency, but a complete test was not attainable, as the machine had to be immediately shipped. A comparison of these curves will render it evident, that it is quite practicable to produce a polyphase motor having an efficiency fully equal to that of direct current motors of similar size, and I think the tendency will be toward better efficiency at moderate loads. It should be mentioned here that the two-horse power triphase motor was made of ordinary good armature iron, not selected or specially treated in this way.

Finally let me call sharp attention to curve 3, which shows the effect of the power factor, which I regret to say has been talked about not wisely but too well in most of the discussions pertaining to polyphase apparatus. Two curves in Fig. 3 show the total current in the line in the two horse power triphase motor and the 110 volt continuous current motor above mentioned. The current curve of the continuous current machine is nearly a straight line, that of the polyphase machine is almost tangent to it and slightly concave upward. A noticeable fact displayed is that throughout the ordinary working range of these two motors the currents were substantially equal, the existence of the power factor in the polyphase motor being only noticeable at very low loads and at over-loads. This comparison should be a sufficient answer to the charges of excessive current that have so often been made against the polyphase machines. In a bad polyphase motor they would have foundation in fact. In a rather good one the net effect of the lagging current is trifling. It should further be noted that the current in this triphase motor at friction load is only about 30 per cent. of the current at full load and of this only 30 per cent. represents loss of energy. This is in marked contrast with the results obtained from a foreign triphase motor of similar size exhibited at the World's Fair, in which the no load current was nearly equal to that at full load and the power factor at full load was barely over 50 per cent.

In this brief discussion of some of the properties of modern polyphase motors, I have endeavored to show how nearly they fulfill the conditions which may be regarded as desirable in electric motors in general. That they do as well as, if not only better than, the continuous current machines of similar capacity, I believe I have satisfactorily shown.

The demand which certainly is arising for polyphase motors for general power purposes based on their intrinsic merits, indicates that the older type of machinery has found a dangerous rival, all questions of long distance transmission aside.

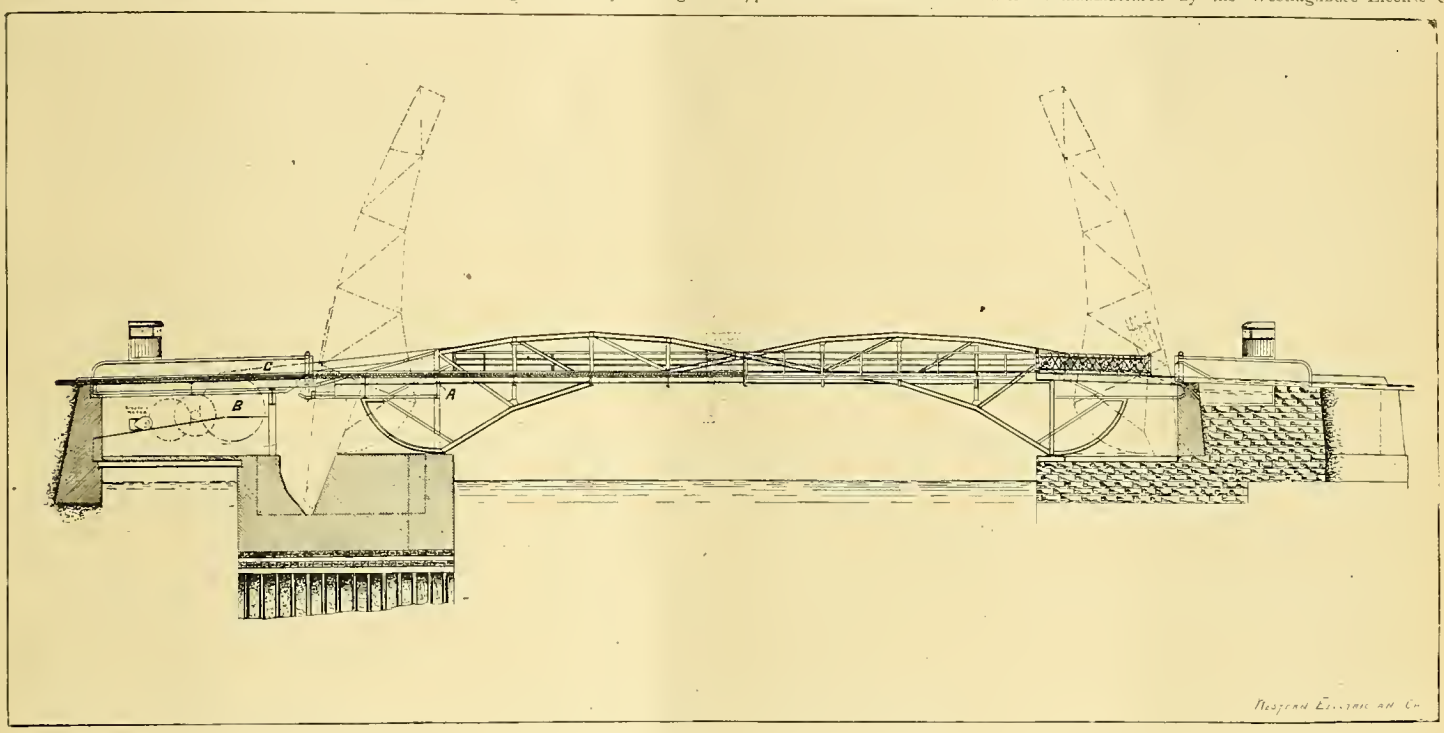
## Van Buren Street, Chicago, Drawbridge Equipment.

While there is nothing new to the readers of this journal in the application of electric motors to drawbridges, the equipment of the Rush and Lake street bridges of Chicago and several bridges in Milwaukee having been already described and illustrated, a particularly interesting application is about to be made to the first of a new class of bridges adopted by the city of Chicago, which is to be in every sense an electric drawbridge. For years the ordinary swing bridge was considered the best and was generally adopted, but in a river where the channel is so narrow as in the Chicago river, the space taken up by the center pier on which the bridge swings makes it objectionable. Efforts to eliminate this feature are illustrated in the "lift" bridge at Halsted street and the "jack knife" bridge at Canal street, both of which are supported wholly on the shore ends with no obstruction in the center.

The bridge to be built across the Chicago river at Van Buren street is in its general design of the Bascule type, a notable illustration of which is the tower bridge in London, which has just recently been completed and opened to the public. In this type of bridge the two sections forming the roadway are hinged or supported on trunnions on the abutments on either side, and raised and lowered at pleasure by power applied by different methods according to the peculiar conditions of each case; but there are numerous objections to this style of bridge when applied to so limited a space as is admissible on the Chicago river. The Van Buren street bridge, however, will embody the desirable features of the Bascule with the objectionable ones eliminated. It was designed by William Scherzer, C. E., it being his last work before his death, and is being erected under the personal supervision of W. R. Roberts, C. E., the engineer in charge of bridges of Chicago.

On each side of the river is a substantial abutment at the base of which, on the river side, is a pier on which lay two parallel horizontal steel rolling tracks provided with raised teeth and in line with the axis of the bridge. On these rolling tracks rest the segmental girders, having their center at *A* in the accompanying plan, and in the face of these girders are pockets corresponding with the teeth on the track. The weight of each section is so distributed that when it is raised to an angle of 45° the center of gravity passes through this center, so if there were no opposing strain a section would oscillate back and forth from its position. The left hand end is shown in section exposing the motors and the train of gears which transmits the motion for the bridge operation. On the deck of the bridge is sbown the operator's stand. The operation of the bridge is as follows: To the center of the circle *A* is attached the operating strut *C*, a rack suitably stiffened by channel beams which engages with the gear *B*. The bridge in its closed position is shown by the full lines. The operator starts the motor which rotates the gear *B*, thereby drawing back the strut which, being attached to the center of the quadrant, causes it to roll back on the tracks, the teeth preventing it from slipping or skewing until it reaches the position indicated by the dotted line, when the motor is stopped automatically and a brake applied. In closing, the operation is reversed, but before the ends are allowed to come together, by means of an automatic device the sections are brought to a full stop, thereby preventing the possibility of an accident through the carelessness of the operator. The final closing can then easily be controlled.

A powerful emergency brake is also provided, which may instantly be applied by the operator, thereby putting the entire operation under his complete control. The electric equipment will consist of four 50 horse power railway type motors, two on each section of the bridge, geared to a single horizontal shaft. Each pair will be controlled independently by a series-parallel controller located in the operator's stand. The controlling mechanism, and particularly the braking devices, are exceedingly unique and interesting, and involve some novel features. The contract for this equipment has been awarded to G. P. Nichols & Bro., contracting engineers, Monadnock building, Chicago. Mr. Nichols is a pioneer in the application of electricity to the operation of large bridges, and has successfully equipped two at Lake and Rush streets, and five in Milwaukee, the satisfactory operation of which has established Mr. Nichols' reputation in this line of work. The motors and controllers will be manufactured by the Westinghouse Electric & Manufacturing company, and will be designed with reference to the unusual requirements of this class of work.




VAN BUREN STREET, CHICAGO, DRAWBRIDGE EQUIPMENT.

## Brewery Analysis by the Aid of Electricity.

In certain brewing operations, says the *London Electrial Review*, it is necessary to determine the amount of invert sugar present in a given liquid, and this is usually effected by means of a chemical process, in which a copper solution plays a prominent part. The copper absorbed by the sugar is then estimated and the sugar calculated from the result. As mistakes are not impossible in this process, and since accuracy is of great commercial moment, affecting possibly the quality of huge quantities of beer, an attempt was recently made by Formanek to estimate the copper (hence the sugar) electrolytically. The process devised has now been modified by B. B. Ross, and is essentially as follows: The copper in the form of cuprous oxide is precipitated in a beaker, then placed upon an asbestos filter, washed with hot water and rinsed with weak nitric acid. The liquid is then made up to 200 cc. and platinum electrodes are introduced, connection being made with a battery giving a current equivalent to 0.5—0.7 cc. of electrolytic gas per minute. The anode employed is a flat spiral of platinum wire of Luckow's pattern and rests on the bottom of a beaker, while a vertically suspended platinum cylinder receives the deposit of copper. The increase of weight of this cylinder gives the amount of copper, and from this the brewing chemist calculates out the sugar. Test analyses show the remarkable accuracy of this method.

The fourth report of the committee on fires of the electrical committee of the Underwriters' International Electric association has been issued by William H. Merrill, Jr., Chicago.

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IN discussing the subject of underground electric railroads for London or tunnels of any sort in that city, several perplexing problems arise at once, not the least of which is the selection of routes which will not conflict with the present roads. It gives an impressive idea of what subterranean London is fast becoming, remarks the London *News*, to learn that on emerging from the river the new City and Waterloo line will, in its passage up Queen Victoria street, run for a part of the way under the low level main sewer, which, in its turn, runs along beneath the district underground railway. So that at this point in the city we shall have, first, a busy main thoroughfare, below that a steam railway, then a huge metropolitan sewer, then an electric railway, reaching its terminus at a depth of about 63 feet below the streets, and here it will communicate with another line—the Central London—which will lie at a depth of 80 feet.

AN interesting contribution to the discussion of electrolytic action of railway currents upon gas pipes, water mains and sewers, is presented in another column in the form of a report to the city engineer of Boston on this subject. The report concludes that "the direct evidence is good, although not yet ample, that injury has been wrought upon iron and lead pipes buried in the earth, this injury being the direct result of corrosion arising from the passage of the return currents of an electric street railway into or out of the pipes. It seems further to be almost incontestably shown that the underground conditions in Boston are such that electric currents, presumably of considerable magnitude, pass into and out of the pipes by way of the earth, and with the unavoidable accompaniment of electrolysis and corrosion." The belief is expressed that under existing conditions this corrosion is a serious factor in lessening the life of the entire piping system of the city, but as the experiments and examinations have not yet been concluded, no positive decision has been reached. Further experiments in this line will be awaited with interest.

IT is gratifying to see the interest that has been awakened in the subject of electro-therapeutics in the medical fraternity and it is encouraging to find men of scientific attainments investigating subjects in this line. Just as soon as the educated physician takes an interest in this work and familiarizes himself with what has been accomplished and what can be done through the application of electricity to medicine and surgery, the electric quack will disappear. The electrical fraternity should assist the medical profession in getting rid of those offensive fellows. No more effective means could be employed than to encourage organizations whose purpose is to promote honest and scientific research and experiments. An association of this kind, which from its professed objects, the work it has already done, and the character of men identified with it warrants the statement that it is a reputable and reliable organization, is the American Electro-therapeutical association, which will hold its fourth annual meeting at the New York Academy of Medicine, September 25th. The list of papers prepared for the occasion has just been sent out by the secretary and the preliminary programme promises a good meeting. Among the gentlemen well known to the electrical fraternity who will read papers are A. E. Kennelly, Dr. Morton, Prof. Dolbear, W. J. Jenks and Prof. Houston. At the present time the medical and electrical fraternities in England are very much worked up over the electric belt controversy that has been kept before the public so long through court proceedings and newspaper discussions. The same methods employed in England by promoters of "electric" healing devices obtain in this country among the quacks who assume to hide their ignorance in the mystery which to the majority of people surrounds everything electrical.

ANOTHER victory for the trolley has been scored in Chicago, where the daily newspapers have been making a spirited fight against the introduction of the overhead trolley system. The aldermen have been warned repeatedly by the newspapers against granting ordinances for electric lines on the ground that the people were opposed to them. In several instances the aldermen have disregarded the advice of the daily papers, and in every case it has been demonstrated that they were justified in so doing. The best evidence of this fact is found in the statement appended which is taken from the *Chicago Record* of Friday, July 26th:

Application to the commissioner of public works for permission to convert the West Van Buren street railway to an electric line was made by the West Chicago Street Railway company yesterday afternoon. This is in accordance with an ordinance passed by the city council April 30th. The plans for the construction have been on file with the commissioner for some time, and the permit necessary to begin the work is expected to be issued at once, as there has been no opposition to the plan.

The Chicago City Railway company has accepted the ordinances passed by the City Council granting permission to substitute electric motors for animal power on several South Side lines. The newspapers have been protesting against the council's action, and it was claimed that the residents of the section to be benefited by the improvement were not in favor of the change. It is probable that nothing more will be heard of this opposition. The electric car has proved to be a popular improvement wherever introduced. This is true in other cities as well as Chicago. According to the *Philadelphia Record* the old suburban lines have found it impossible to successfully compete with the trolley, and the management acknowledged it. A railroad official is reported as saying: "Of course they can't touch us on long distance traveling, but in the near future I expect to see them absorb a large amount of our suburban travel." The trolley has proved itself to be admirably adapted to this service and there is no doubt that in this field there will be rapid development in the near future.

AMONG the most practical and at the same time enthusiastic advocates of technical education for electrical workers is Prof. Shepardson of the University of Minnesota, whose work is already beginning to show good results in the Northwest. Prof. Shepardson gave some very good advice to the members of the Northwestern Electrical association at the St. Paul convention on July 18th. His paper on "The Relations Between Technical Schools and Electrical Industries" should be read by every one interested in raising the standard of electrical work. His advice and criticism apply to the East as well as the West, and his suggestions deserve respectful consideration everywhere, for he has given much thought and time to the matter of preparing young men for responsible positions in stations and in factories, and is thoroughly competent to speak on the subject. The advantages of technical education are now pretty generally appreciated, but there are some who still cling to the belief that education unfits a man for "practical" work. Where shop practice and laboratory work are combined with classroom lectures, as they should be in every institution of this kind, the young man who has had the advantage of a course is vastly better equipped, and, other things equal, will doubtless outstrip his less fortunate neighbor who is obliged to gain his knowledge through experience. Prof. Shepardson points out the advantages that are being derived by the electrical business, and, through it, by the public at large, from educational institutions providing technical and engineering courses, and in return he asks the managers of electrical concerns of all kinds to co-operate with these educational institutions and give them such encouragement and assistance as they may be in position to offer. Very few people realize how great has become the interest in electrical pursuits. One example cited by Prof. Shepardson will serve to convey some idea of the growth of the classes pursuing purely electrical engineering courses. In ten years the number of students in the electrical department of Cornell was increased from 28, the number entered in 1884, to 361 who took the course in 1894. This is, indeed, a phenomenal record, but there are others quite as striking. At the University of Minnesota, for instance, half the entire number of pupils in the engineering schools are following the course in electrical engineering, and the department is still comparatively young. Much more could be said in the same line and many instances cited to show the growing importance of the work, but enough has been presented to demonstrate the fact that there is a general appreciation by managers of electrical concerns of the work that is being done in these universities. But those engaged in this work need encouragement and assistance, and those who are most benefited by their labors should look after the interests of these institutions.

ON Tuesday, July 25th, the rapid transit bill, as passed by the Legislature and signed by the governor, was accepted by the people of Boston at a special election, at which 29,706 votes were cast. This measure has been under discussion for a long time and has been earnestly advocated by many prominent business men and owners of real estate in the localities to be benefited by the improvement, yet it is surprising that such a small vote was cast and that there was such a narrow margin in its favor, the vote standing 15,403 for, as against 14,303 opposed to, the measure. It is always hard to get the people out on such occasions, and it is probable that only those directly affected by the project signified their wishes. Friends of the bill contend, too, that while it is likely that every person opposed to the measure voted against it, many who favored it did not take the trouble to record their opinion. But the bill has been accepted and that is the principal point; a step in advance has been taken, and Boston is nearer the solution of the problem of rapid transit than any other American city. Under the bill just accepted by the people provision is made for the building of a road from Sullivan square, Charlestown, to City square, to Haymarket square, to Dock square, to Postoffice square, over the Federal street bridge and over Dorchester avenue to Milton. Branch lines may be built to Malden, Beachmont, Crescent beach, Chelsea, Marine park, South Boston, Neponset, Somerville, Cambridge, Roxbury, Brookline and some other lines. No work can be done until the proposed routes shall be approved by the mayor and aldermen or the selectmen of the city or town, nor can the construction of the bridges be begun until the location and plans shall have been approved by the railroad commissioners. It is also provided that within six months from the acceptance of the act the corporation must apply for locations for five miles of track, and on or before the first day of February of next year, or 30 days after the approval by the mayor and aldermen of this route, deposit with the state treasurer the sum of $300,000 which shall be forfeited if the corporation shall fail to build five miles of road within two years from the approval of such route. The corporation must also deposit with the state treasurer $200,000 additional before it begins the construction of any of its line. The latter portion of the bill provides for the construction of a subway under Tremont street, one under the river to East Boston, and one under Washington street. Two new transit commissioners are provided for, to be appointed by the governor, whose salary shall be $5,000.

It seems to be the general opinion that the project will be pushed ahead rapidly and that Boston will be the first city in the country to have a complete rapid transit system. It is certainly to be hoped that the Boston commissioners will be more expeditious than the members of the New York board, who required several years to discover that they were utterly incapable of coping with the task they had undertaken.

## The Relations Between Technical Schools and Electrical Industries.[1]

By Prof. G. D. Shepardson.

The rapid growth in the number and extent of the applications of electricity in modern life has excited the wonder of all. The amount of capital invested in electrical interests in the United States is probably not less than $2,000,000,000. The number of persons finding employment is some hundreds of thousands. New discoveries are being made continually, and new industries are being built upon them. Each new line of industry stimulates others, and the growth is electrical in a double sense.

The question is often asked: Where are the men obtained who manage these great interests? How can men be trained to superintend and handle such large central stations, electric railways, telegraph and telephone lines, manufacturing establishments and carry them on successfully? The men in charge, or most of them, were out in the business world long before the schools began to teach electrical engineering, and the number of graduates from such courses to-day is far less than the number of positions to be filled. How, then, are men found or trained for handling these concerns successfully?

The answers are various. Some are not carried on successfully. Mortgage foreclosures, receiverships and suspensions are not unheard of in electrical circles, and in many cases they could have been prevented by the employment of competent electricians.

The successful management of many electrical plants or manufacturing establishments requires a knowledge of men and business more than a knowledge of technical details.

Vast numbers of mechanical, civil and other engineers have turned with the flood, and by hard study, harder experience, and, perhaps, still harder nerve have picked up such knowledge of electrical matters as was necessary to make them successful constructing or supervising engineers of electrical plants. It is well understood that most of the applications of electricity require more mechanical knowledge than electrical. It is, therefore, comparatively easy for men already familiar with machinery to become electrical "experts," so-called, in a short time. Most of the electrical manufacturing works have more or less thoroughly organized shop schools or courses of work for training "experts" who are sent out to install or overhaul plants sold by the parent company. These men often accept positions with the local companies and remain in charge.

Most of the state universities and some other institutions of learning have organized departments of electrical engineering which are doing something to supply men who, after some practical experience, will be able to take positions of more or less responsibility.

The growth in the technical schools is something like that of the other electrical industries. Five years ago the institutions offering courses in electrical engineering might be numbered on the fingers of one hand. Now there is hardly a state that does not boast one or more schools offering such courses on paper at least.

The number of young men looking to electricity as a means of earning a living is indicated to a very limited extent by the number of students entering the courses in electrical engineering at Cornell University, for instance. There were twenty-eight students in this course of 1884. In 1894 there were 361. At the University of Minnesota about half the number of students in the entire engineering college were in the electrical engineering. The technical schools have graduated a considerable number of men since the electrical courses were established, and some of these men have reached eminent positions as engineers, designers and inventors. The number of graduates is as yet comparatively small.

A natural result is that the larger proportion of the men at the head of electrical interests are not what are known as "technical graduates;" they have not taken regular college courses in electrical engineering, and, indeed, many of them have not seen the inside of a college. One might be tempted to ask: What, then, is the need of technical schools if these men can do the work successfully? If such a question were asked of one of those successful electrical men themselves he would be very likely to answer: "I would give almost anything if I could enjoy such advantages myself." Some practical men have still a wrong impression of the work done by the technical schools. They have seen or heard of some kid-gloved dude with eye-glasss and cane posing as an expert from a well-known professional school, and have set it down in their minds that technical schools are theoretical, and that they train boys to be utterly impractical. To these it should be said that the schools have to work upon the material that comes to them, and some of the material is exceedingly green. As a general rule students who lack the qualifications for becoming engineers are discouraged and either quit school or change it over to other lines more congenial.

It is worth noting in this connection that the greatest advances in different electrical fields are being made by college men. Sir Wm. Thomson's mathematical powers and skill in the use of laboratory instruments made it possible to operate the first trans-Atlantic cable. The inventors of the telegraph and telephone are generally known as Prof. Morse and Prof. Bell. Recent investigations of the possibility of telephoning across the ocean have all been made by college graduates, adepts in mathematics. The recent developments in transmission of power by alternating currents are almost entirely due to college men, whose mathematical investigations were tempered with practical experience.

The technical schools are more and more emphasizing the the fact that success in engineering may be won only by hard and unceasing work, and each one must learn theory and practice together. He must temper his theory with practice; he must govern his practice by theory.

The students are urged to spend their Summer vacations of three months in electrical factories, repair shops, electrical light and railway stations, in wiring or wherever opportunity may offer to obtain actual experience in practical work. Under favorable circumstances they are urged to continue their practical experience a full year before returning to complete their technical course. Those who follow this plan find that they have a better appreciation of the work in the laboratory and lecture rooms, and when they graduate are far better prepared than those who do not obtain such practical experience during their course. In many cases after graduation they return to work for the same concern with which they have spent their vacations, and they are doing most excellent work.

The work of the course is made as practical as possible. This is especially true of the schools in the West and Northwest. Here there is little need for purely theoretical men. A thorough grounding in theory in desirable, but much importance must be given to actual experience.

The student should learn what is being done and how it is being done. They must be given actual experience in measuring, testing and operating electrical machinery and apparatus in the laboratories. They must be given and must solve difficult and actual problems so that they may know how to handle any of the perplexing questions that keep confronting the man in business, whose stockholders are looking for dividends and not assessments. The trend of technical education in the West seems to be to teach theory, but especially theory as it bears on commercial practice.

We may next inquire, What are the desirable relations between the technical schools and the men engaged in electrical business? Relations involve two parties and should be mutual. It is believed that the mutual relationship between the technical schools and the electrical interests has not received the attention it deserves.

Speaking first from the standpoint of the schools. We desire to help the electrical interests in this section of the country in every possible way. That is why the electrical engineering departments were established and that is why men are devoting their lives to this department. We aim to be of service in the following ways: By helping to educate men who will become efficient superintendents of local electrical companies, who will improve and maintain efficient service in electric light and power stations in telephone and telegraph exchanges and similar places, who will help raise the standard of construction and repair work, who will help develop new industries and who will be of good service wherever they may locate.

To older men who have had more or less experience in practical work, and who desire to improve themselves, the facilities of the libraries, laboratories and class rooms are extended. Every possible opportunity is offered to men of mature years to carry on any work within the scope of the university for which they are prepared.

The libraries are being enriched by the completion and binding of complete files of the technical papers and by the addition of the best books. The equipment laboratories are being made more perfect each year and opportunities for practice and investigation are being increased continually.

The well equipped libraries and laboratories and shops of the technical schools offer exceptionally good opportunities for the organization and development of inventions, and many valuable processes of manufacture and improved appliances owe their success to work done in college laboratories. Only one notable instance may be given, namely that of the electric reduction of aluminum by either the Cowles or Hall process, both of which processes were worked out by young men soon after graduation, Cowles from Cornell and Hall from Oberlin.

The schools have done and are doing much to solve problems and to carry on investigations that are beyond the facilities of the factories or that would consume too much time, space and money. The schools are prepared and are doing good service in providing men and apparatus for making expert tests of efficiency of operation of central stations, machinery and other equipment. Testing bureaus for standard inquiry, measuring instruments, and for other expert tests are being established in connection with many of the laboratories.

Lawyers, inventors and investors often find it of great advantage to be able to look to the state university to obtain disinterested and reliable expert opinions from competent men who are unbiased by any connection with local or distant manufacturing or other electrical companies.

To sum up, we say we are trying to be of service to you in every way possible. If you have suggestions or criticisms they are welcome. We are for use, you are invited to use us.

It would be more fitting, perhaps, for some one actively engaged in business to discuss the other phase of the subject—the relation of the industries to the schools. Some points may be mentioned.

We are pleased to acknowledge the encouragement given us in finding positions for graduates and for students. These men come to you as helpers and not as supplanters trying to push out some one else. They are not as a rule conceited, but have learned that there is much that they do not know, much they can learn from those who have not been to college. They are anxious to learn and generally have a good share of common sense to start with. The schools would be more useful if the men in business would use them more as employment bureaus. If you send to the technical school when you have a vacant position to fill or a chance for a young man to get a start in practical work, past experience indicates that it will prove to be to your advantage.

You can help the school by sending them samples or specimens of results of peculiar accidents, samples from your scrap heap, showing how different material and apparatus stand use and abuse, pieces of discarded apparatus, with reasons for disuse, instruments or other articles that are of historical interest as showing the development. Such articles would be welcome additions to our growing collections, which are of great value in educational work.

It would be useful if you would inform us from time to time of special problems that rise in your work—possibly we might help you.

Lastly, if you can help others to obtain a more thorough education by sending them to the university or by giving them opportunities to work with you, it will be in the right direction.

1. Read before the Northwestern Electrical association, St Paul July 18, 1894.

## The Modern Dynamo.[1]

By Gilbert Donaldson.

The dynamo occupies a very noticeable position in the engineering work of the present. Probably no other class of apparatus of similar importance has been brought to so high a state of perfection in the same amount of time. If we stop to consider the development of the dynamo since Faraday made his first machine, we cannot but be impressed by the brief period covered by dynamo history. As a result of profound study and much experiment we have the modern dynamo; simple, durable, compact, efficient and beautiful, it stands with no superiors and few equals—one of the great achievements of the nineteenth century.

The modern dynamo stands side by side with the modern steam engine; its equal in mechanical design and in adaptability to its work, and vastly superior in its efficiency. Durability, compactness, low repair bill, a neatness of finish and symmetry of design are some of the lines along which we look for improvement in the modern dynamo. Another very important line is the reduction of the cost of manufacture. At present there seems to be a strong tendency toward machines which have as little machine work about them as possible. To reduce the cost to a minimum and at the same time keep up the standard is the goal of the dynamo and motor manufacturer.

In the larger sizes, the direct connected, slow speed multipolar dynamo seems destined to become the popular style. Just where the line between multipolar and bipolar machines is found is an open question. Some claim that the multipolar machine is the best for all purposes and that they would not build bipolar machines at all, while others maintain that for the small and medium sizes the bipolar is cheaper and more satisfactory, and that multipolar dynamos are best adapted for heavy work.

In the best modern practice both types have a firm foothold and there does not seem to be at present any strong tendency for either one to displace the other.

One of the questions that interests the manufacturer is the question of cast and wrought iron for the magnetic circuit. It seems that the best practice must be a combination of the two, provided there are any joints in the magnetic circuit. It is like the question of the proper degree of saturation; it is somewhat local and depends on the relative cost of copper and iron as well as the price of labor.

The dynamo, like all classes of machinery, must of necessity differentiate. That there will be a universal system or a universal machine is not to be expected. Adaptability to special service ought to be and will be the rule. The alternator, the direct current, constant potential, and all the rest have a sphere of usefulness in which they can excel the other types, and in which we may expect to find them competing not with all machines but simply each with others of its own type.

During the last year several new constant current machines have been brought before the public, and the question of their theory and design has been discussed to some extent. The multipolar direct constant current, closed coil, arc dynamo is the latest thing in dynamo construction, and if the designers would give the public their mathematics and theory it would be received as gladly as was their new successful multipolar generator.

The difficult points of these machines seem to be in getting good automatic regulation and sparkless commutation. Much has been said about the shape of pole pieces for the arc dynamo. It has been claimed that the brushes must always be under the polar tips, that the field must be uniform, and that it need not be so, that the polar tips should not be saturated, and that the single magnet type is not adapted for arc machines. I have done some experimenting along this line and have found that so far as the sparking goes, it cuts a very small figure what shape the pole pieces are, excepting in one case. However, this is a very important one. If the dynamo is run say 25 to 50 per cent. below its real capacity almost any kind of a pole piece will not spark, but above this the case is altogether different, and the shape has much to do with the sparking. The real point is to get sparkless commutation at maximum output. This can be done by putting plenty of iron in the polar tips. The effect is to give a more uniform field throughout and also to provide sufficient induction to balance the self inductor of the short-circuited coil when the brushes are well around toward the neutral plane on line where the induced electromotive force changes sign. No special shaping is necessary, the requirement simply is to make the tips heavy and rather full. When the poles are made this way it allows the lines of force to spread out toward the tips and thus be of more uniform density.

Another interesting way of securing a fairly uniform field and entice the lines toward the polar tips is to make continuous pole pieces. By doing so a very uniform field may be secured, but it has the disadvantage of reducing the capacity of the machine.

Another very modern idea is the direct constant current arc machine without a regulator. Here again is a case in which we would like to know the why and wherefore, and the secret of success.

We see at once that there is yet much to develop in some lines of dynamo construction, both in theory and in practice.

Our engineers are thoroughly conversant with the needs of the times, and no other class of apparatus is receiving more careful study and attention. The modern dynamo has a firm hold on civilization, and if the next 25 years mark as great progress as the last we may expect something about as perfect as human skill can furnish.

1. Read before the Northwestern Electrical association, St. Paul, July 19, 1894

## Directly Connected General Electric Generators.

The new type of directly connected multipolar generator for lighting purposes which the General Electrical company is manufacturing is shown in the accompanying illustration. The magnetic circuits are shortened and a greater output with a higher efficiency can be obtained from a given weight and speed than usual. The frames and pole pieces are cast from a special soft steel of very high magnetic permeability, and the construction of the armatures is such that a constant current of air circulates through the core and windings and provides the necessary ventilation. The armature windings consist of straight copper bars so connected as to render short circuits or similar troubles practically im-

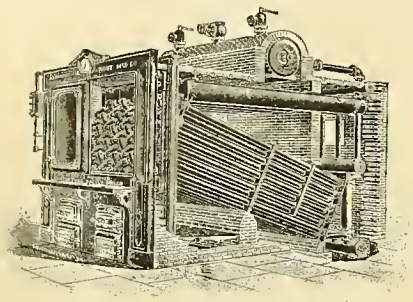
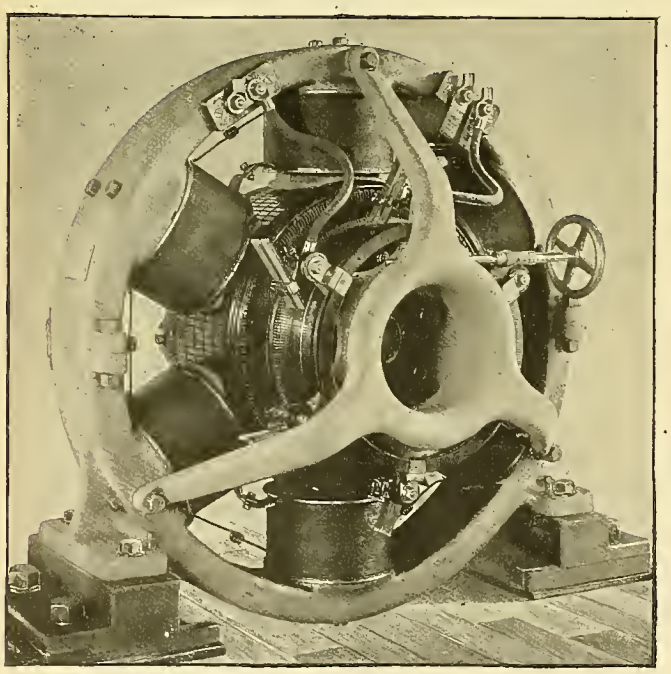


FIG. 7. IMPROVED ROOT BOILER.

possible. The insulation is built up of alternate laminations of tough paper and sheet mica, joining high spark resisting qualities with great mechanical strength and durability. The machines are designed for very small rise in temperature at full load, the limit on the standard machine being only 40° C above the surrounding air after a continuous run of 10 hours, while in the dynamos constructed for the U. S. government the limit is reduced to 28° C.

The ironclad armature derives its name from the manner in which the core is slotted. When the conductors are placed in the slots they become practically imbedded in the body, and thus the iron of the armature being brought closer to the pole pieces, the reluctance of the magnetic circuit is reduced and the capacity for a given weight increased. The copper when placed in these slots is not penetrated with magnetic lines, the total flux passing through the teeth. Large solid copper bars may be consequently used as conductors without loss from eddy currents, and the armature winding becomes an ideally simple mechanical



DIRECTLY CONNECTED GENERAL ELECTRIC GENERATORS.

structure. The commutators are bolted directly to the body and a flexible strip connects the sections of the windings with the commutator bars. On the larger sizes, the clamping ring holding the commutator bars is made in sections. The brushes are of woven metal gauze upon which form of brush the General Electrical company holds the fundamental patents. These generators are made in sizes ranging from 25 kilowatts to 80 kilowatts, and for speed ranging from 300 revolutions in the smallest to 90 revolutions in the largest. They may be connected directly to horizontal engines of the Corliss type or vertical engines of the marine type, triple or quadruple compound. The smaller size may also be connected to engines of the high speed type.

## Fan Water Motor.

The accompanying illustration shows a late and interesting invention, a water motor and fan combined. It is called Bolgiano's electric fan water motor. It takes the place of an electric motor and fan, costs nothing to run, as it connects with any faucet, and does not require any attention or extensive repairs. This pleasing little fan and motor combined has found favor wherever it has gone, and the mere fact that its "current" costs nothing, makes it valuable for offices, stores and private houses. It is placed on the market by the Bolgiano Manufacturing company, Baltimore, Md.

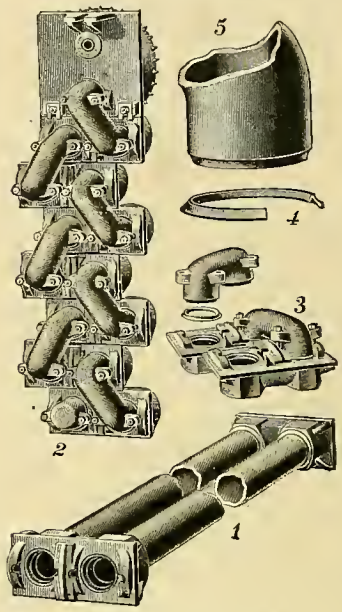
## Improved Root Boiler.

This popular water tube steam boiler is built solely by the Abendroth & Root Manufacturing company, 28 Cliff street, New York. A general idea of its construction may be obtained by inspecting the illustration presented herewith. Two parallel boiler tubes four inches in diameter are expanded into a header at each end, Fig. 1, forming what is known as a package. These packages are then piled one upon the other as shown in Fig. 2, and on top of this pile is

FAN WATER MOTOR.

placed a steam and water drum, all forming a vertical section. A side view of this arrangement is shown in Fig. 7. The openings at the front and rear ends of these box-like headers are connected by means of connecting bends as shown in detail in Fig. 3. These, in turn, have plug-shaped ends, Fig. 5, which are drawn tightly into elastic metal packing rings, Fig. 4, seated in the headers, Fig. 6, this being done by mean of two bolts, thus forming a joint which can easily be "made up" and kept tight. The bolts holding the bends in place have ball-shaped heads which are received in spherical sockets in the headers, thus giving the nut end of the bolt perfect freedom of motion. After connecting the headers front and rear, in the manner described, it will be seen by referring to Fig. 7 that as the water inside the inclined tubes is heated, it will rise in them to the headers, and then will flow upwards from one box-like header, through the connecting bend into the one above it, and so on to the top, and thence into the overhead drum at the front end. This overhead drum is about half full of water.

By constructing the vertical section in the manner described, it is made a flexible one, which can readily adjust itself to the unequal expansion of the tubes which always takes place, without placing dangerous breaking strains on the various pressure parts, especially on the vertical section. In making up a boiler, a number of these vertical sections, each virtually a complete boiler in itself, are placed side by side, the height and width of the arrangement of tubes being governed first by the amount of heating surface required, and also by the space available in which the boiler is set. The method of construction at the rear ends of the boiler is shown in Fig. 8, where four boilers are seen. Over the top of the several steam and water drums is shown the multiple which collects the steam from each, and finally delivers it into the steam drum. About the




FIGS. 1—6. IMPROVED ROOT BOILER.

center, beneath the steam and water drums, is shown the feed drum, below which is seen the mud drum. When the complete boiler is constructed the headers are arranged similar to bricks in a wall, that is, with their vertical joints broken, and as a brick can easily be removed from the lower part of a wall and replaced without disturbing those around it, similarly a package of tubes can easily be removed and replaced in the boiler when the fittings at the end of the package are taken off. This arrangement also brings the tubes in a staggered position vertically, which prevents the gases from having a free, uninterrupted run back to the chimney, thus insuring a more perfect absorption of the heat.

In placing this boiler in position when it takes the place of old shell boilers, the necessity for tearing up the sidewalk or street is obviated, as it can be introduced into a building

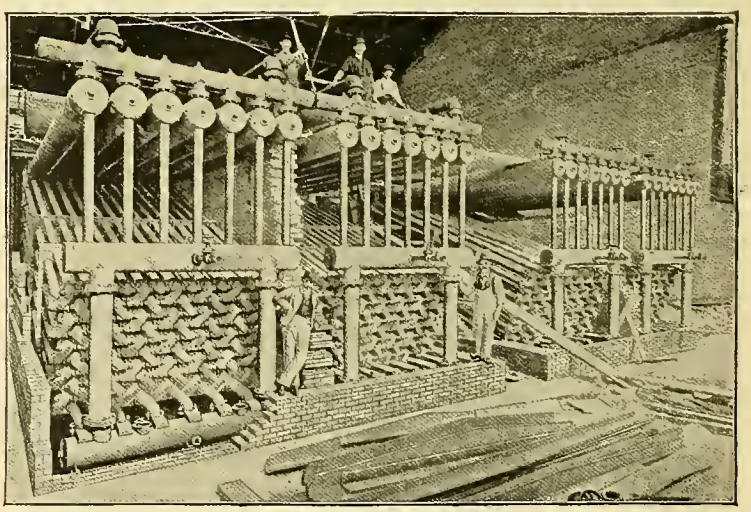


FIG. 8. IMPROVED ROOT BOILER.

through an ordinary window or door, an opening 39 inches square being sufficient for the introduction of a boiler of 350 horse power capacity. The old shell boilers can be cut up by a boilermaker right in position, and so taken out and the new boiler put in with but little trouble and expense. Durability is one of the strong points in favor of boilers of this type. The improved Root boiler is built entirely on the interchangeable system, so that any part may be slipped out and a new part introduced at a minimum cost, and in a very short time. Thus, by keeping up with the deterioration which takes place in all boilers, it is always kept practically as good as new; the same high pressure can always be carried, and at the end of twenty years it is about as good for service as at the end of the first year.

## Feeder Wire Splicer.

The feeder wire splicer shown in the accompanying illustration was brought out last year by the Ohio Brass company, Mansfield, O., and has met with almost universal approval from construction men. Besides making a practically perfect joint in the feeder wire, it saves enough time over the ordinary manner of splicing to more than pay for its first cost. It can be used as a permanent or temporary connector. In making a splice the insulation is first removed and the halves of the splicer are placed over the abutting ends of the bare wire. The nuts are then screwed on the tapered ends of the splicer, which is slightly corrugated on the inside, thus securely clamping the wire. Solder can be poured through a slot provided for this purpose. A joint made in this way is but a trifle larger than the wire and is of low resistance and great strength, the average electrical resistance being about .02 of an ohm, and the mechanical strength of the joint being greater than the wire itself.

FEEDER WIRE SPLICER.

## Slow Speed Motor of the Mather Electric Company.

The Mather Electric company is calling attention to its Manchester type slow speed motor, an illustration of which is presented in Fig. 1. The fields are of cast steel, while the base, sub-base, etc., are of cast iron, thus making the motor of particularly light weight for the output. The field-coils are wound on metal bobbins, perfectly insulated, and can be slipped on and off the field magnet with ease. The bearings are of the Mather company's improved self-oiling type, with composition bushings. The armature, Fig. 2, which is exceedingly large, is of the iron clad slotted type and of the modified Siemens winding, insuring slow speed. Great care is taken in building it up; the shaft, which is very large in diameter, is of the best machinery steel; the core is of sheet iron disks, which, by an improved annealing process, together with a proper insulation of wire, does away with destructive heating. The insulation throughout is of the best obtainable, mica being used exclusively. All armatures are carefully balanced before being sent out, and, the company claims, will operate without vibration. The commutator is of improved design, exceedingly massive and carefully insulated. Every part of the Manchester type slow speed electric motor is made to jigs and templets and can be duplicated at once from stock.

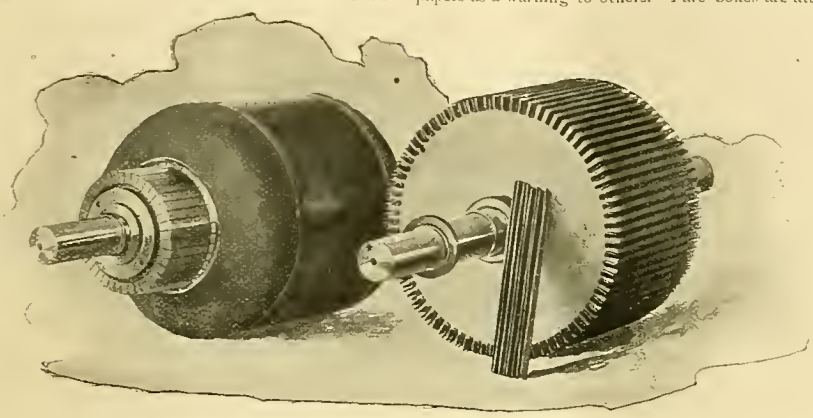


FIG. 2. SLOW SPEED MOTOR OF THE MATHER ELECTRIC COMPANY.

## The Trolley in Chemnitz, Saxony.

In a report to the State Department, United States Consul J. C. Monoghan describes the principal features of the trolley system in Chemnitz, Saxony, and the effect of the improvement in the business of the company. The use of poles is obviated, the wires being fastened by means of ornamental rosettes secured to the woodwork or walls of houses, having projecting hooks to which the wires are attached. These hooks are firmly fastened and are tested with seven times the weight they will be called upon to bear. Owners of houses without exception preferred to allow the use of their houses free rather than have posts on the sidewalk. The streets through which the cars wind their way are wider than Washington street, Boston, or Westminster street, Providence. The system has now been in operation for six or eight months, and has proved satisfactory and successful. The railway tracks, in conformity to the law, are level with the pavement, and accidents to vehicles of all kinds are rare. The gauge is narrower than in America, but the cars keep the track and run as rapidly and smoothly as in the United States. In the heart of the city they run 220 yards per minute, and in the suburbs 330 yards per minute.

The increase of traffic since the introduction of electricity has been 60 per cent., notwithstanding the strenuous opposition to the change and the year of exceedingly hard times. The cars have no conductors. The motorman is the only person on board who represents the company. By doing away with conductors the company saves 44,000 marks annually. The fare is only 10 pfennigs, or a trifle less than 2½ cents, on all routes, including transfers. Should 150,000 persons evade payment in twelve months the loss would be only 15,000 marks. It would take 450,000 evasions in fare to offset the company's savings by dispensing with conductors' salaries. Culprits in this regard when detected are punished by having their names advertised in the newspapers as a warning to others. Fare boxes are attached to both ends of the car, so there is no such excuse offered as "difficulty in getting forward."

## An Improvised Telephone Line.

There is, perhaps, no other business in which it is so often necessary to resort to temporary expedients as that of the constructing electrician. Conditions vary so that to be successful a man must be possessed of a considerable amount of versatility and adaptability to circumstances. As an illustration of this, the experience of Edwin Plowman, who is at the present time engaged in installing a D'Unger telephone exchange at Crookston, Minn., is amusing. Mr. Plowman vouches for the following story:

The fair for Northern Minnesota was held at Crookston last month, and although no line work had been done, Mr. Plowman, at the request of the editor of a daily paper published there, determined to connect his office and the race track. He ordered a mile of wire and a couple of sample D'Unger telephones, but the railway strike hindered delivery and the material arrived only two days before the opening of the fair. When Mr. Plowman attempted to string his wire he found that owing to a mistake he had only about one-quarter enough wire. It was then Saturday night, and as the fair was announced to open upon the following Tuesday it was obvious that there was no time for another shipment to be made. Mr. Plowman had evidently made up his mind that conversation was going to be carried on between the office of the newspaper and the fair grounds over his telephone line, for he spent Sunday looking for wire. He was rewarded by finding a spool of No. 18 annunciator wire, and that carried about one-third of the way. Then he went to the town electric light works and secured all the wire there, but when it was strung there was still a shortage of about 1,000 feet. What to do next he hardly knew, as there was no more wire in the county and St. Paul was 300 miles away. Determining not to be balked he bought stovepipe wire enough to finish, and grounded on a long iron rod, which he drove into the ground and wet with a couple of pails of water. Mr. Plowman says that he connected his telephones and secured satisfactory service on a line one-and-a-half miles long running on electric light poles, over houses and factories, on fences, across the prairie on 12-foot poles, with five different kinds of wire, ranging in size from No. 18 to No. 8, and in pieces from six to 600 feet long. There were probably 100 splices in the line, most of the wire being in short pieces. The editor received his report, and Mr. Plowman had the satisfaction of knowing that he had fulfilled his promise.

## Large Electric Railway Plants.

The tendency for very large electric directly coupled generators, especially for railway power plants, has been illustrated again in a contract just closed between the West Chicago Street Railway company and the Siemens & Halske Electric company of America, for three 2,000 horse power and one 1,000 horse power generators.

The station is to be located on the property of the company on Washington boulevard and Western avenue. The company's repair shops and stables are located there, and it is considered that the situation is particularly convenient for an electric power station, because of the central location in the territory which is to be served. The station which will be constructed there is intended to ultimately accommodate five 2,000 horse power generators and one 1,000 horse power.

Work is to begin on Van Buren street immediately. The line will have to be entirely rebuilt. About three miles of street will be converted into electric line, the cars being taken at Halsted street and connected with cable. The motor cars will be hitched onto the cable cars so there will be no delay in making connections. Mr. Chapman has devised a scheme for disconnecting the electric machinery in the motor car while the train is being drawn by the cable. The bids for the electric machinery called for the completion of the first dynamo within four months of the award of the contract. The contract calls for the completion of an additional machine every fifteen days. The contract for the engines will be let immediately. The West Side power system is ultimately intended to operate electric lines on sixty miles of street, and the West Side company contemplates converting 120 miles of horse car lines into electric lines.

The contracts for the construction of the North Side power house and for the engines and machinery were let Monday. The power house will be located on the river opposite Sharpshooters' Park at California avenue and Roscoe boulevard. The station will ultimately take in generators aggregating 6,000 horse power. At present it is only

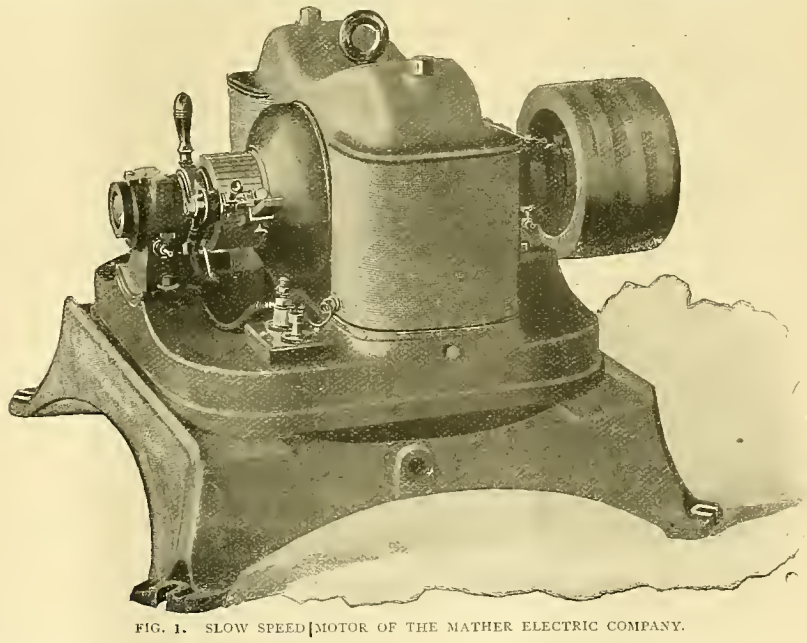


FIG. 1. SLOW SPEED MOTOR OF THE MATHER ELECTRIC COMPANY.

the intention to operate 135 cars from that station, and the contracts which were let Monday called for generators aggregating 2,800 horse power. Contracts for the engines were let to the Fraser-Chalmers company and for the electrical machinery to the Siemens & Halske Electric company of America. The generators at the North Side station are intended to operate both North and West Side lines. The territory which will be covered will embrace all the lines of the North Chicago Street Railroad company and will also furnish power for all the West Side lines north of North avenue. Power will also be furnished for a new line which is to be constructed on Elston avenue from Chicago avenue northwest. This Elston avenue line is being built by the Chicago Electric Transit company, a corporation that obtained an ordinance some two years ago. At present there is supposed to be no direct connection between that company and either the North Side or West Side companies, but it is intimated that ultimately the West Side company will absorb that property. The entire electrical plants of the two street railroad companies embrace double tracks on 100 miles of street. It is expected that the first electric cars will be in operation early next year, and others will be rapidly equipped after that. The cross town lines can be got ready to operate by electricity rapidly, for they will not have to be rebuilt. All lines laid within the last year or two were put down with the intention of changing them from horse to electric, and nothing will be necessary but to string the trolley wires.,

The Siemens & Halske Electric company of America, which during the last two years has been exploiting large directly coupled units both for lighting and power service, has already erected or has now under construction, the following plants in the United States and Canada: Garden City Construction company, Chicago, four 620 horse power generators; West Chicago Street Railway company, Chicago, three 2,000 horse power generators, one 1,000 horse power generator; Johnson & Edwards, contractors for Nassau Electric Railway company, Brooklyn, N. Y., three 667 horse power generators;, Toronto Street Railway company, Toronto, two 1,400 horse power generators; City Railway company, Dayton, O, three 400 horse power generators; Ringing Rocks Street Railway company, Pottstown, Pa., two 135 horse power generators; Cincinnati Street Railway company, Cincinnati, O., one 650 horse power generator, making a total of 16,400 horse power.

This list gives the rated capacity of these generators only, while those that have been in actual service, it is claimed, have shown their capacity to stand an overload of 50 per cent. for hours without harm or flashing on the brushes.

### Fatal Explosion.

Three men were killed in an explosion at Dolese & Shepard's stone quarries, near Chicago, on Tuesday, July 31st. The victims were F. Corbin, Scott Clark and Richard Clark, employes of the Western Electric company, Chicago. They were engaged at the time of the explosion experimenting with a device for igniting cartridges by electricity. C. H. Rudd was also seriously injured. The details of the accident have not yet been learned, and it is not known whether the explosion was due to a premature discharge or caused by a spark from a passing engine falling in the powder magazine.

## CORRESPONDENCE.

### New York Notes.

NEW YORK, July 30.—The Brooklyn Traction Trolley company objected to the payment of a tax on the $1,015,500 assessed valuation of its property last year, and brought suit in the Supreme Court to sustain the claim that it had no real or personal property subject to taxation. It was contended that the capital stock of the company was invested in the shares of the Atlantic Avenue company, which had been already taxed. Justice Gaynor has decided in favor of the company. He says: "The relator, the Brooklyn Traction company, is the owner of shares of stock in the Atlantic Avenue Railroad company. It may no more be taxed upon said shares than may any other owner of shares in the said company be taxed upon his shares. This is obvious; but nevertheless the Legislature, in a spirit which, except for the occurrence of this case, would have to be deemed needless caution, has commanded assessors in the marshalling of the assets of corporations for taxation to exclude or deduct all shares of stock owned by them in corporations whose capital is taxable."

The State Railroad Commission has granted the application of the Coney Island & Brooklyn Railroad company to introduce the trolley system on its Ocean avenue line from the Willink entrance of the park to Franklin avenue, to the Ocean Parkway and Fort Hamilton avenue, to Gravesend avenue and Greenwood Cemetery. The Brooklyn city authorities contended that the company had no right to string the trolley wires alongside the park property, although the Board of Aldermen had granted it the privilege, and when work was begun the police stopped it. The decision of the Railroad Commission will now end the controversy, but the company will have to comply with the regulations of the local authorities in the construction of the road. The commissioners say that the board is on record as approving the trolley system, and sees no reason why the change in motive power should not take place in this instance.

The Electric Machinery Guarantee Corporation is the title of a new company formed here to insure electrical plants against damages of any nature, and also against loss of life and casualty. The company will confine itself strictly to electrical apparatus. The capital stock is $200,000, and the organization of the company is expected to be completed by September 1st.

Four men were discovered last Saturday afternoon in a vault under the sidewalk in front of that portion of the Hoffman House which has been recently torn down in the act of cutting the telegraph wires which pass through the vault and into the telegraph offices in the neighborhood. After a struggle between the men and policemen one of the wire cutters was captured, while the others made their escape. The offices of the Western Union, Postal and Gold & Stock Telegraph companies and the Commercial Cable company have experienced considerable trouble during the last two weeks by interference with their wires, and the managers of the several offices in the tenderloin district have been at a loss to explain the cause. Less than a week ago one of the wires running into Manager Jacobson's office, at Twenty-sixth street and Broadway, stopped working, and an examination showed that it had been wantonly cut. Manager Jacobson and the police are at a loss to understand the object of the men in tapping the wires, unless it was conceived for the purpose of beating the races by delaying the returns. Why the men should cut the wires of the cable company and the local wires of the telegraph companies they cannot explain, because there is no doubt in their minds that, while the man arrested is undoubtedly ignorant of telegraph matters, he was apparently accompanied by men who understood the whole network of wires. It is thought that perhaps the cable wires were cut to give access to the wires the men wanted to reach. The wires of the Commercial Cable company were cut last week, causing a delay of two hours. A Western Union cable, containing 13 wires, was cut on Thursday, and one was cut Saturday afternoon several hours before the discovery of the wire tappers was made. Inspector Morris of the Western Union Telegraph company said that he believed that the men cut the wires for the purpose of stealing the wire, but he could not explain what they could do with it. He said that some of the wire had been taken away. W. F. O.

### St. Louis, Mo.

ST. LOUIS, July 28.—In the Circuit Court of the United States last spring, Judge Philips heard the suit of the city of St. Louis against the Western Union Telegraph company. He has now filed his opinion finding for the defendant. In 1888 the city brought action in the Circuit Court of the United States against the Western Union Telegraph company to recover $22,625 under a city ordinance providing for the payment of $5 per telegraph pole for the privilege of using the streets, alleys and public places. Judge Thayer rendered a decision for the defendant. The case was appealed to the United States Supreme Court, where the judgment was reversed and remanded for a new trial. The Supreme Court decided that two questions were involved and should be considered on retrial: First, whether the first ordinance of 1881, permitting the company to erect poles and stipulating that the top cross arm be set aside for the city wires, is not in reality a contract which would debar the city from exacting an additional payment of $5 per pole; and, second, is $5 per pole exacted by the last ordinance a reasonable rental price? The court held that the $5 per pole exacted by the ordinance is not a privilege or license tax but is a rental price for the use of such part of the streets and alleys as is occupied by the poles of the company. Judge Philips, of the United States Circuit Court, before whom the case was retried, answers the first question in the affirmative, thus annulling the second ordinance. On the second question he says that some difficulty attends the ascertainment of what is the rental value of the streets for this purpose. There is no precedent by which the market value or rental price of streets or alleys can be determined. Comparing the value of real estate abutting the lines of telegraph wires Judge Philips says that a rental charge of $5 per pole is so enormously greater than that of the abutting property as to render this exaction absolutely unconscionable. The city introduced firemen who testified that the presence of wires was a source of trouble in case of fire. Judge Philips could not see that this should enter into the estimation of the value of pole space in the streets and alleys. The city also introduced, as witnesses, persons engaged in the business of advertising by posters who testified that they would give $5 per pole for advertising purposes. But this, the judge held, is hardly a legitimate test of the rental value of such property. Furthermore Judge Philips estimates that 1,500 poles occupy a space equal to a lot only 18 by 100 feet which at a rental value of $7,500—the annual pole rental—would indicate a real estate value of $125,000, a valuation, entirely without foundation in St. Louis. For this reason he finds for the defendant. The city counselor filed a motion for a new trial which Judge Thayer overruled. The case will go to the Supreme Court.

The new power house of the Lindell Railway company, located at Thirty-eighth street and Park avenue, is finished and the machinery is now being erected. The building is fireproof throughout and consists of three parts, boiler room, pump room, and engine and generator room. In the boiler house is being erected eight Sterling water tube safety boilers with a capacity of 325 horse power each. Water will be supplied by a spring furnishing 75 or 100 gallons per minute. The water will be collected into a cistern with an overflow into sewers. An elevated coal track runs directly into a fireproof coal shed. The coal is delivered on an inclined floor from which it slides through chutes in the main wall into the boiler room as needed. In the engine and generator room, three Southwark high speed engines belt connected to three 750 horse power Westinghouse generators are being placed in position. The engines and generators are set on solid concrete foundations. Wide subways are provided for carrying the wires to the main switchboard. The switchboard of marble will be located in the north wall, outside of which is a brick wire tower into which 60 feed wires enter through wooden tubes. During the last year the Lindell Railway company has constructed about 20 miles of new track, namely, the Taylor avenue railroad, eight miles, and the Compton Heights Union Depot & Merchants Terminal railroad, 12 miles. The latter line runs over the main line from Third street west on Washington avenue, south on Eighteenth street, passing the new union station at Eighteenth and Market streets, to Chouteau avenue; thence west to Mississippi avenue, south to Park avenue, west to Nebraska, south to Shenandoah and west to Tower Grove park. The Taylor avenue railroad is a cross town line leaving the main line at Delmar and Taylor avenue and extending northward to Bellfountain cemetery.

The Johnstown electric track welding machine has finished welding the track of the Baden & St. Louis Railroad company, and the road is now in operation. No difficulty or displacement of rails has occurred.

The Prairie avenue division of the Union Depot railroad is now in operation. This line starts at Fourth and Pine streets and runs over the old line by the way of Pine street, Ninth street and Clark avenue to Eighteenth street, thence north over the tracks of the Lindel Railway company on Eighteenth street to Washington avenue, then north on the new line by the way of Eighteenth, Nineteenth, Twenty-second and Twenty-third streets and west on Hebbert street to Prairie avenue. On Hebbert street there is an extension eastward which connects with the Benton-Bellefontain division. This new division gives the Union Depot Railroads company a direct cross-town connection between its northern and southern divisions and also a direct connection with the new union passenger station at Eighteenth and Market streets. Power is supplied from a north side power house, two directly connected 500 horse power generators having been erected for this purpose.

The Grand avenue railroad, which has lately been sold to the Union Depot Railroad company, will be pushed to completion. The change in ownership, however, makes a change in the power plans. The power house contemplated by the original owners will not be erected. The Union Depot Railroad company having two large power houses already in operation will supply power from them. An 800 kilowatt generator directly connected to an Allis-Corliss engine will be erected at the south side power house.

The completion of the Grand avenue division will give the Union Depot Railroad company a total mileage of about 80 miles of track and make it the longest line in the city.

The Municipal Assembly has adjourned until October. The bills providing for the construction of a general subway system for electric wires remain in the hands of the committee. R. J. H.

## PERSONAL.

The sudden death last Saturday night of Mrs. Margaret A. McKinlock, the mother of the gentlemen of that name who are so well known in electrical circles of the West, will be the cause of sincere regret. Mrs. McKinlock was 64 years of age. Some time ago she was injured in alighting from a carriage, and it is probable that her death may be indirectly traced to this accident. At the time of her death she was stopping at the house of Walter C. McKinlock, 14

Groveland Park. The funeral took place Monday afternoon at 3 o'clock. George McKinlock, president of the Central Electric company, William H. McKinlock and Walter C. McKinlock, president and secretary of the Metropolitan Electric company, will receive the sympathy of a host of friends in their loss.

## ELECTRIC LIGHTING.

Municipal lighting is being considered in Berlin, Germany, a proposal having been brought forward at a recent meeting of the Municipal Council that the latter should acquire and carry on the electric lighting stations of the Berlin Electricitatswerke.

The Hudson, Mass., Electric Light company has sued the town of Hudson for $18,000 damages for failure of the town to purchase the electric lighting plant, after having voted twice in open town meeting to accept the provisions of an act allowing towns to own and operate electric light and gas plants. The papers were served last month, and are returnable on August 1st. The company claims damages from the fact that the action of the town was sufficient to deter several concerns from either purchasing the plant outright or furnishing additional capital to increase its facilites. It is further claimed the conditions of the suit and the relations of the company to the town are similar to if not identical with those of the town of Wakefield and the electric light company of that place, the recent decision of the court being that the town of Wakefield should purchase the plant at a considerable advance on the original price.

A state of affairs regarding electric lighting in Japan, which is not without its moral, has come to light in connection with the recent celebrations of the silver wedding of the Mikado of Japan, when the Imperial palace was lighted by no less than 1,000 candles, says an English journal. Originally the rooms were lighted by electricity, and the magnificent electroliers constituted quite a feature of their internal decoration. It appears, however, from a Japanese paper that the installation, although superintended by a foreign expert, was more or less defective from the first, and complete confidence in immunity from fire was never felt. After the destruction of the parliament buildings some years ago by fire, which catastrophe was generally attributed to the electric lighting, the Mikado conceived a dislike and distrust of that method of illumination, and that fact supplementing the uneasiness already felt about the security of the installation in the palace, settled the doom of the whole affair, candles having ever since been used.

## ELECTRIC RAILWAYS.

Several capitalists of Fort Wayne, Ind., contemplate the establishment of an electric railway to connect the surrounding suburban towns with Fort Wayne.

The electric railway station at Sherman, Tex., has been burned. Five cars were destroyed, and the loss, it is said, was not less than $10,000. The company will rebuild at once.

Several capitalists in Gloucester county, N. J., are making efforts to get the Camden, Gloucester & Woodbury electric railroad extended to Clarksboro, Mullica Hill and Swedesboro.

The trustees of the village of Green Island, N. Y., have passed a resolution giving the Troy City Railway company permission to change the motive power of its cars from horse to electricity.

Work has been begun on the trolley lines of the Traction company at Bridgeport, Conn. The contract for the building of the power house has been awarded to Henry Doremus, one of the directors.

All arrangements are being made and contracts awarded for the rapid construction of the Grand avenue electric railroad in St. Louis, Mo. October has been fixed for the date of completion of the line, and construction will begin within 30 days.

The Rochester, N. Y., Railway company will soon have guards on all its electric cars. A number were placed on the Lake avenue route this month, and the rest of the lines will be fitted out as rapidly as possible. The cars will be fitted out at the rate of two a day.

The County Court and the City Council of Hannibal, Mo., have granted the electric car line company a franchise to extend its road to Indian Mound Park, a beautiful park about two miles from the business portion of the city. Work on the extension will be pushed as rapidly as possible.

The contract for the St. Louis, Mo., & Kirkwood electric street railway has been awarded to a local firm. The railroad company will pay $75,000, and will ask as much more from the property owners along the line. It is the purpose of the company to increase its capital stock to $300,000.

The opening of the power house of the Grand View Beech Railway company, which operates a road between Charlotte, near Rochester, N. Y., and Manitou Beach, was celebrated recently. The company's former power house was destroyed by fire last spring. The new plants is expected to furnish light for Charlotte and current for a new electric fountain just installed at Manitou Beach as well as for the railway. The fountain takes current at 510 volts and is 50 feet in diameter. It cost about $15,000.

In a paper in the *Schweizerische Bauzeitung*, discussing street railroads with special reference to the new electric road at Zürich, in Switzerland, P. Schenker points out, among other things, that while in the United States about 60 per cent. of all the street railroads are worked electrically, representing about 7,500 miles of road with about 17,000 cars in use, there are, at the present time, in operation in Europe only about 260 miles of electric street railroad, with an equipment of 720 cars. These are divided up among about 50 different companies. A number of roads, however, are now under construction, and will help somewhat to swell this meager total.

Aachen, Prussia, has begun the construction of an electric railway, which is to be carried out by the Elektrizitats-Aktiengesellschaft. Current for the line will be obtained from electrical works constructed by the same company, and about 14 miles of line will be laid; but as soon as service is begun on this length an extension of about 18 miles will be undertaken. The tramway will be double line throughout and for the most part quite level, although on portions of the route gradients of five per cent. are frequent, and at one point the gradient attains a maximum of eight per cent. The line will be constructed on the overhead trolley wire system, the cars taking current in the usual way. The first equipment will consist of 34 cars, 19 of which will be equipped with 15 horse power motors for hauling trail cars, and the remainder will be supplied with 10 horse power motors.

## POWER TRANSMISSION.

Electric power is being transmitted 14 miles in San Juan county, Colo. The current is generated at Ames to operate the Belmont mill.

The Southwestern Electric Light & Power company is about to remove its plant from Grand Falls to Joplin, Mo. The action is taken to enable the company to be near its source of power and for other economic considerations.

A project is on foot to generate electricity by water power at the mouth of Sooke lake to supply Victoria, B. C., with light and power. Goldstream lake, which is somewhat nearer the city, is also spoken of as possessing many advantages for this purpose.

The Riverside Shoe factory at Dixon, Ill., is now run by electricity. This concern receives its power from the Dixon Electric Light & Power company, which transmits to the factory current sufficient to run two Edison motors of 25 and 30 horse power each. The Dixon Shoe company has been run by electricity for over a year.

Electrical power transmission at Austin, Texas, is so far realized that the large dam across the Colorado river, work on which was begun some months since, has been completed. The city council was authorized by popular vote to issue bonds in the sum of $1,500,000 to construct the dam and plant, but these bonds, as yet, have not been negotiated. The dam is located three miles above the city.

The Edison Sault Electric company, Sault de Ste. Marie, Mich., has secured a big sub-contract from Hughes Bros. & Bangs, the new lock contractors. The contract is for drilling about 15,000 holes in the bottom of the new lock for bolting down the floor of the lock. A compressor of capacity sufficient to operate six drills will be required, and it will take all this season to complete the drilling of the holes, which will be in solid rock. The compressor will be operated by a powerful electric motor, supplied with current from the Edison Sault Electric company's plant.

An electric power transmission plant has recently been installed at Burrida, Austria-Hungary. The machinery, which is driven by water power, comprises three generating machines of 150 horse power, and three motors of the same power. The energy generated is transmitted to the cotton-spinning mills of Amman & Co., one at Pordenone, and one at Fiume, at distances of 2½ miles and 6½ miles respectively. It is stated that a syndicate has acquired the Austrian and Hungarian patent rights of carborundum and is establishing works for its manufacture at Benatek. The machinery at the works is to be driven by electricity, it being intended to put down a plant for the electrical utilization of available water power.

## TELEPHONE.

A new bill has been introduced into the Massachusetts Legislature by the Bell Telephone company to replace the bill vetoed by the governor last month. It asks for the increase of the company's capital stock to $30,000,000, the new stock to be sold at auction.

The St. Louis *Globe-Democrat* tells the following story: "A man who had been born and raised away back in the hills, where neither telegraph nor telephone was known, was brought in on a charge of horse-stealing. It was suspected that he had stolen several horses, but the evidence against him was not very strong. The detective had him in his office and cautioned him that if he did not tell the truth the information would come against him through the funny looking instrument in the corner. The man laughed and said that he was not as ignorant as he looked, whereupon the detective rang up the chief's office, and by a preconcerted signal the suspected thefts of the prisoner were called through the 'phone in a very gruff voice. The detective placed the 'phone firmly against the prisoner's ear, and his astonishment when he heard his thefts narrated was ludicrous. His innate superstition proved his ruin, for he promptly admitted his guilt and gave information which led to the recovery of most of the stolen horses. The mountaineer's disgust when informed how he had been tricked was very palpable, but he still declined to believe that one man could talk to another along a wire."

## MISCELLANEOUS.

Permission was granted by the Swiss government authorities during last year for the establishment of 34 electric lighting plants (26 on the continuous current system, and eight on the alternate current), five electric power transmission plants, seven combined electric lighting and power transmission plants, and one electric tramway.

To avoid thefts in cloakrooms, a man is reported to have invented a special peg on which a coat or hat may be hung. The peg is connected with a small electric battery and bell. When the weight of the coat or hat is on the peg it cuts off the current of electricity and the bell remains silent. Immediately the article of apparel is taken off the peg the bell rings, calling the attention of the cloakroom attendant to the fact of the removal.

Some interesting experiments are to be carried out in connection with the use of search lights for night attacks, and in the practice of besieging operations at Thorn by the German army during its forthcoming manœuvres, says the London *Electrical Engineer*. The plant consists of an 18 horse power portable engine, with dynamo and searchlight. The projector is not used directly, but through the medium of a mirror about 600 feet distant, so that the enemy is unable to fix the position of the plant. The mirror has an electric motor attached to it, which is connected to the dynamo by means of two cables. This allows of the mirror being moved to any desired angle by those in charge. A similar arrangement will be used in the naval manœuvres for the defense of ports.

## BUSINESS.

The Berlin Iron Bridge company, East Berlin, Conn., has received the contract from M. C. Henry & Co. of New York, to cover their stoneyard with an iron roof, and also for a traveling crane. The building will be 50 feet in width and 100 feet in length, constructed entirely of iron, the whole space to be controlled by a traveling crane.

The Dow Adjustable Light company, Braintree, Mass., reports an increasing sale of the Dow adjusting ball for electric lights. The Dow adjusting ball is a mechanism for instantly raising or lowering an electric light and is especially adapted for stores, offices, hotels, libraries, or any place where a movable light is required. Dow's patent fusible connection for attaching a drop light to a chandelier or electrolier is also meeting with an increased sale.

On January 1, 1894, the Western Electric company decided to establish a branch house in St. Louis, placing one of its oldest construction men, H. V. Smith, in charge. Since that time it has done a remarkably large business considering the hard times, through this house. Mr. Smith has secured for his company contracts amounting to approximately 14,680 incandescent and 430 arc lights in Kansas City and St. Louis. The Western Electric company now has about 30 successful plants in St. Louis.

The United Electric Corporation has entered the electrical field. The company is incorporated under the laws of the state of Minnesota and the charter provides for manufacturing and dealing in all kinds of electrical machinery and appliances. For the present, however, the United Electric Corporation will confine its business to telephones and telephone supplies. The company is well organized and starts out under favorable auspices. Mr. Grant, the president of the company, is a prominent capitalist in the Northwest, while Paul Bossart is a favorably and widely known electrician and pioneer in the telephone business. The office of the company is at 811 New York Life building, Minneapolis, Minn.

The Knott Manufacturing company, 796 Seventh avenue, New York, has placed upon the market a commutator lubricating compound that is meeting with much success. It is compounded upon entirely new principles, and overcomes many of the objections to the majority of similar articles now sold, as it is made up only of vegetable substances and is said to contain no vaseline, paraffine, beeswax or glycerine. It can be applied to all descriptions of electric motors and is reported to have proven a great economizer of brushes and commutators. It has been endorsed by the Thomson-Houston Electric company, the Mt. Morris Electric Light company, the Edison company, and some of the principal electric plants in New York.

One of the peculiar things about the electrical supply business is the suddenness with which a demand will sometimes spring up for an article which before has been scarcely known to the trade. A case in point recently has been the demand for porcelain tubes for insulating purposes, caused by the more strict insurance regulations. The demand for these goods is so large just at present that the factories have difficulty in turning them out fast enough. The Electric Appliance company, Chicago, anticipating to some extent the present condition of the market in this respect, arranged some time ago to carry a very large stock of these goods, and it is in a position at present to meet all demands. It has also just issued a complete catalogue of electrical porcelain goods, and is distributing this book among the trade.

The village of Harlem, a suburb of Chicago, advertised some time ago for bids on an electric light plant for village lighting. A number of companies put in bids on dynamo capacity of 100 1,200 candle power arc lamps and 70 lamps put up in the streets of Harlem; also on necessary boiler and 100 horse power engine. The contract was awarded to the Seckner Contracting company, which was the lowest bidder. The village board, however, reserved the right to specify the electric system. After much deliberation it decided upon the Siemens & Halske Electric company, which is to furnish and erect the electric machinery as sub-contractor to the Seckner company. The Siemens & Halske Electric company will use a 500 volt multiple series system, and a constant potential dynamo in connection with its band arc lamps. F. N. Armour, well known from his former connections with the Chicago Edison company and the Northwest Thomson-Houston company and who is now city salesman for the Siemens & Halske Electric company, secured this contract for his firm.

Pierce & Richardson, electrical engineers, 1409–1410 Manhattan building, Chicago, have issued a prospectus and announce that they are prepared to undertake the drawing up of specifications and the designing of complete lighting

and power stations. Special attention will be given to thorough testing and inspection of power and lighting stations and isolated plants for conditions of safety and economy of operation. Reports will be made on any class of electrical work considering points regarding fire protection, increased economy of plant, as well as devoting attention to the removal of causes affecting the successful working of the installation. Photometer and laboratory testing will also be a feature of the work of the firm. In this connection it may be mentioned that Pierce & Richardson have an extensive and thoroughly equipped laboratory and a most complete line of testing instruments. The firm will be in no sense a contractor, and is not associated or connected in any way with manufacturers of dynamos, motors, transformers, etc., or with any supply house. Mr. Pierce has had 12 years' practical experience in engineering. As electrical engineer of the World's Columbian Exposition he had the supervision of the installation and operation of every class of commercial electrical machinery manufactured in this country, as well as much apparatus of foreign make. Mr. Richardson has had 10 years' experience in electrical engineering, and was in charge of the electrical inspection department of the World's Fair; also planning and laying out the lighting of the grounds. He is thoroughly posted as to the cost and quality of electrical supplies and appliances, having had in charge the light and power department of the Ansonia Electric company for over a year.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

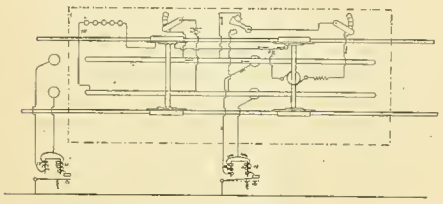
*Issued July 24, 1894.*

523,354. Electrically Propelled Perambulator. Emil E. Keller, Chicago, Ill. Application filed April 20, 1892.

The object of the invention is to provide convenient means by which electricity as a motive power may be applied to perambulators such as are useful for moving persons about through a building, exposition or the like, as well as on the street.

523,369. Electrical Igniting Device for Gas Engines. Alonzo J. Painter, Pasadena, Cal. Application filed July 28, 1893.

The patent describes an igniter for a gas engine so constructed that small contact points or electrodes and springs within the ignition chamber will be provided, and to construct these electrodes of such size, shape and material as to be capable of withstanding the excessive heat and wear within the ignition chamber, and also to so construct the device that the electrodes can be easily adjusted or replaced when worn out without disturbing the other parts of the engine.



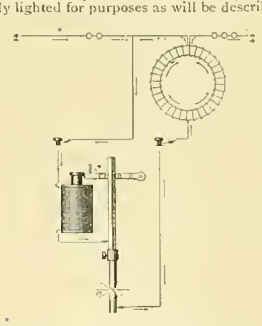
NO. 523,396.

523,371. Secondary Battery. Antoine E. Peyrusson, Limoges, France. Application filed November 1, 1893.

In the battery described by this patent the positive electrode is constructed of a number of very thin lead strips or laminæ autogenously soldered to a central rod of pure or antimoniated lead. The strips may be arranged vertically, in which case their ends are soldered to disks of pure or antimoniated lead of a few millimeters in thickness, each strip being thus secured at three of its edges and being free at its outer edge only. The number of these strips should be considerable, so as to themselves constitute the positive electrode without the addition of a material such as litharge, red lead, etc. The negative electrode is constituted by lead plates corrugated in a novel manner. According to the invention the lead plates are coiled in the form of a hollow cylinder, and each corrugation or fold is slit for a portion of its length in order that both faces of the negative electrode may be rendered active and the capacity increased. The ends of the plates are inserted in and intimately soldered to top and bottom rings of pure or antimoniated lead. The parts are thus rigidly secured together: this result being further insured by the employment of a number of sufficiently strong vertical strips, which serve to unite the corrugated plates to which they are autogenously soldered. The strips are also soldered to the rings, and one of them is continued upward to form a conducting tang. The negative electrode in this manner constitutes a hollow cylinder in which the cylindrical positive electrode is received with an intervening space of about two-fifths of an inch, all contact between the two electrodes being prevented by the employment of insulating caps or covers. The two electrodes are plunged in a sulphuric acid solution of 25 degrees Baumé contained in a suitable vessel. The accumulator is formed by reversing the direction of the charging currents, as for a Planté cell.

523,395. Multiple Filament Lamp. Albert L. Clough. Manchester, N. H. Application filed August 2, 1893.

This invention has for its object the production of a multiple filament incandescent electric lamp, in which the filaments may be illumined together in one order to produce a dim light, and in another order to produce a brilliant light, or one may be separately lighted for purposes as will be described.



NO. 523,401.

523,396. Electric Railway System. Albert C. Crehore, Ithaca, N. Y. Application filed July 20, 1893.

This invention, to which reference may be made in the drawing, relates to systems in which the moving car derives its current successively from working conductors, each of which is automatically connected to the line as the car passes, and disconnected from the line when it has passed by the operation of a magnetic switch. It has been proposed to use on the car a storage battery which should act, under certain conditions, to operate the magnetic switches and to provide means for charging the battery by current taken from the main line. It has also been proposed to use what may be termed auxiliary conductors, which provide a path for the current energizing the switch magnets. In this invention the battery, instead of being in a shunt around the motor, is in a branch around the magnet. A combination with the series of working conductors of a contact or contacts adapted to move from one section to another without break of circuit, a series of magnetic switches for connecting this section to a line, an auxiliary conductor over which the magnetic switches may be operated, and a storage battery in a branch of the power circuit on the car around the auxiliary conductor branch are provided.

523,401. Method of Working Arc Lamps. William S. Horry, New York, N. Y. Application filed October 17, 1893.

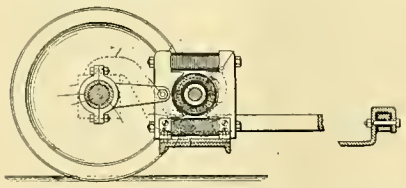
Use is made of an induction coil magnetized substantially to saturation and of particular design. The functions of this coil are two-fold: it effects the transformation necessary to give the required current when the lamp is working, and it causes one or more constant potential arc lamps to regulate properly in series upon a constant current alternating main. By this invention certain constant potential or alternating current arc lamps may be used in series upon mains in which the current is kept constant by any means, and the method consists in magnetizing the core of the transformer substantially to saturation, whereby an increase of voltage in the secondary circuit is prevented, so that an increase of resistance at the arc results in a decrease of current passing the solenoid, which causes the lamp to feed.

523,444. Controlling Mechanism for Electric Motors. Charles H. Richardson, Philadelphia, Pa. Application filed April 26, 1894.

The invention relates to certain improvements in means for starting, controlling the direction of rotation, varying the speed and instantly arresting the motion of electric motors, as well as for switching off the current when the motor is thrown out of operation.

523,453. Mode of Mounting Dynamos on Car Trucks. William Biddle, Brooklyn, N. Y. Application filed October 6, 1893.

In carrying out his invention, which relates to the manner of supporting and actuating a dynamo, the inventor supports the dynamo directly from the equalizing bars of the truck, the dynamo resting upon a platform or cross girder whose respective ends are fastened securely to the equalizing bars, and at which point of connection a perfect insulation may be established. The armature shaft of the dynamo is provided with a pinion which is engaged by a wheel upon the car axle, and he provides connections from sleeves upon the car axle to one of the pole pieces of the dynamo, so that the dynamo is maintained in a constant relation to the car axle in order that the operative contact of the driving wheel and pinion may not be obstructed even if there is a slight endwise movement of the equalizing bars or lengthwise movement of the car axle. In the improvement the entire weight of the dynamo is carried by the equalizing bars and the transverse platform or girder connected with them. A sectional elevation and a detail of cross section is shown in the accompanying drawing.



NO. 323,453.

523,460. Incandescent Electric Lamp. Francis M. F. Cazin, Hoboken, N. J. Application filed December 7, 1892.

The inventor has devised an electric lamp designed for operation on the principle of incandescence, in which the semi-conductive material intended and adapted for being electrically heated to incandescence, is not necessarily a filament surrounded by an empty space, but is such matter of any degree of cohesiveness or non-cohesiveness, such as powder, etc., in the shape of a solid line of a minute transverse section, embedded entirely and directly in a solid, non-conducting, mainly transparent material, such material being either entirely glass or faced with glass, so as to permit the radiation of light; and the carbonaceous or other semi-conductive material so embedded, in the form of a solid line, is connected at the ends to leading-in wires of metal, preferably of platinum, the incandescent material, together with the connection as stated, being hermetically sealed against the access of any air to the incandescent matter. The figure at the left in the accompanying drawing is a plan of a lamp having two films or masses of semi-conductive or carbonaceous matter, the films or masses being shown at the face of the lamp in ornamental shapes for producing special effects.

523,461. Electric Incandescent Lamp. Francis M. F. Cazin, Hoboken, N. J. Application filed July 24, 1893.

This invention is an improvement upon the lamp illustrated in the preceding patent, and it is concerned with making the lamp as described still more effective by selecting the material for the cover or top part with a view to utilize aside of the incandescence of the film also the dark heat rays emanating from it under electric current for heating the cover and causing the cover to become luminous itself, thereby utilizing a higher percentage of the energy applied in the production of light, all of which is effected by making the cover of opaque or semi-opaque material.

523,471. Electric Snow Plow. Louis J. Hirt, Somerville, Mass. Application filed November 20, 1893.

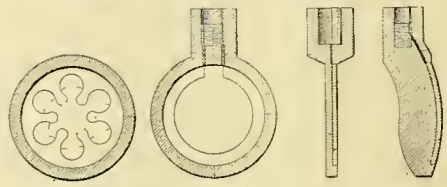
This invention relates to a snow plow for electric street railways, and has for its object to provide a strong, compact and efficient snow plow capable of performing the work required, and constructed so that the operative parts of the plow are readily accessible, and may be quickly and easily handled.

523,491. Block Signal System. George L. Thomas, Brooklyn, N. Y. Application filed March 26, 1894.

The invention relates to an improvement in block signal systems in which series of signals arranged along the track and connected by electric circuits, in the present instance by track circuits, are under the control of a train moving in either direction, each series serving as rear signals or header signals according to the direction in which the train is moving, the one series serving as rear signals when the other is serving as header signals. It also contemplates the placing of the signals normally in auxiliary circuit independently of the main track circuit or the line circuit for preventing the disturbance of the signals, and further contemplates provision for dropping the semaphore arms into an abnormal position in case of breakage of the cord or chain which sustains the signal actuating weight.

523,566. Electricity Counter. Francois A. Brocq, Paris, France. Application filed September 21, 1893.

The inventor claims as a portion of his invention in a counter for measuring an electric current, a vessel containing a liquid in combination with a float in the vessel, a core connected to the float for operating it, a magnetic coil in the circuit of the current to be measured, acting magnetically on the core to operate it, a switch operated by the float when the core of the latter is moved by the coil, means for restoring the float to the initial position when it has operated the switch, and a counter for recording the movements of the float.



NO. 523,460.

523,572. Electrical Converter. Robert H. Hassler, Dayton, O. Application filed August 4, 1893.

The object of the invention is to produce a converter having the primary and secondary coils of approximately cylindrical form, with the material comprising the magnetic circuit applied to the coils in such a manner as to almost completely utilize the space within the center of the coils, and at the same time be so arranged with reference to the exterior of the coils that the radiation of heat from the coils is greatly facilitated.

523,586. Starting and Controlling Device for Electric Motors. Joseph W. Moore, Boston, Mass. Application filed April 25, 1894.

This invention relates to certain improvements in controlling devices for electric motors, and is adapted particularly for use on electric motors for constant potential circuits employed for operating elevators where the motor is started and stopped at the will of the operator from the car or platform

523,613. Telephone Switch. Jacob O. Ziegler, Boston, Mass. Application filed May 10, 1894.

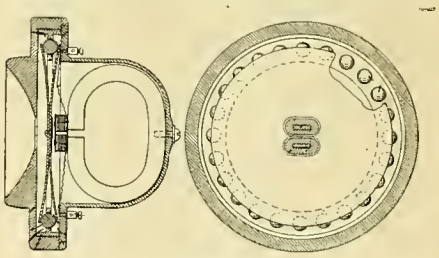
A manually operated automatic or gravity telephone switch is described, the intention being to obtain any requisite force necessary for moving the switch, which may be constructed to insure perfection and certainty of operation.

523,617. Signal Telegraph Claudins. V. Broughton, Buffalo, N. Y. Application filed November 13, 1893.

This patent describes an improved construction upon a device previously patented by the inventor (453,178). This construction consists of a number of electric lamps arranged in a continuous line, a bed plate of non-conducting material, a series of metal strips insulated from each other in the bed plate, and each electrically connected with a separate lamp, and contacting plates, each operated by a separate key to complete the circuits through different groups of the metal strips to light the lamps necessary to produce the character desired.

523,625. Trolley Catcher. Edwin M. Drummond, Louisville, Ky. Application filed March 3, 1894.

The invention provides a trolley pole support so constructed that when a trolley wheel leaves a conductor from any cause the pole automatically assumes a position out of danger of striking cross or guard wires, and from which assumed position the pole may be set to its original position by means of a rope attached thereto.



NO. 523,630.

523,630. Telephone. Stephen D. Field, Stockbridge, Mass Application filed April 7, 1894.

The invention comprises a compound telephone diaphragm mounted on supports which permit free radial movement thereof, and which may, for example, be ball bearings: a diaphragm so constructed and mounted, being applicable as an armature not to telephones only, but to electro-magnets of any class, and comprises also a telephone combining such a peculiarly formed and arranged diaphragm or armature with its other essential elements and operating parts. In attaining the object of the invention the inventor takes two or more substantially similar diaphragms, and rivets them together at their centers. He then separates or springs them apart at their edges, and maintains such separation by the interposition of balls of suitably hard material, such as metal, or of other similar mechanical appliance which will allow radial movement of the diaphragms when subjected to vibrations in the usual manner, either by magnetic variation or by the impact of sound waves. In the drawing *A* is a longitudinal cross-section of a magneto telephone embodying the invention, *B* is a section looking toward the diaphragm, which is partly broken away to more clearly show the radial supports.

# Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, AUGUST 11, 1894. No. 6


## Electrical Equipment of the Cass Avenue and Fair Grounds Railway, St. Louis.

As an example of directly connected practice for electric street railway work the plant of the Cass Avenue & Fair Grounds Railway company in St. Louis, Mo., is interesting, not only owing to the fact that its machinery consists of large units and has made a splendid record since its installation, but because it was among the first plants in this country to illustrate the growing tendency for engine dynamos of large capacity for power purposes.

The railway is a consolidation of the Cass Avenue, Northern Central and Union lines, which until 1892 were operated independently of each other. Originally the line was built for horse cars, but upon the consolidation of interests electricity was adopted as a motive power and the change in equipment speedily made. This road as well as the St. Louis Railway company's is owned by a Chicago syndicate, of which D. G. Hamilton is at the head. The power station is located upon Prairie avenue, and faces St. Ferdinand avenue. The building, with a frontage of 164 feet, is built of St. Louis pressed brick and red sandstone trimmings. A roadway, eight feet wide, runs the entire depth of the building and separates the engine room and the boiler room. It is covered by a half-story, which connects the two rooms, and which is used as a storeroom. Through this driveway coal is delivered to the furnaces through doors in the boiler room, which is depressed about 20 feet below the level. Three sheet steel smokestacks, each 100 feet in height, tower above the building.

A view of a portion of the dynamo and engine room, comprising two of the large machines, the smaller one and the switchboard, is presented in Fig. 1. A more general view of the room and one including all of the machines is shown in Fig. 2. As may be seen the generating equipment consists of four electrical units, three of which are of 750 kilowatts capacity and one of 200 kilowatts capacity. They are of the General Electric multipolar type for street railway work and run at speeds of 92 and 150 revolutions per minute, the larger machines having 10 poles and the small one six poles. These generators are directly connected to four Reynolds-Corliss engines, made by the Edward P. Allis company of Milwaukee, the sale being made by Albert Hoppin of the Chicago office of the company. Three of these are of 1,000 indicated horse power capacity, the contract calling for engines between 880 and 1,200 horse power. Their cylinders measure 34 by 60 inches, and the machines run at a speed of about 92 revolutions per minute. The cylinders of the smaller engine are 18 by 36 inches, and it runs at the speed of 150 revolutions a minute. All the engines are of the single cylinder, non-condensing type with the 1890 frame. The flywheels of the large machines are 20 feet in diameter. The larger engines have been worked up to 1,500 horse power, one-half more than their indicated capacity. As a matter of fact the station equipment has so far exceeded its calculated capacity that one large generator may be held in reserve during the heavy load in addition to the small generator, which is used to operate the "owl cars" which run from midnight until 5:30 A. M. The dynamo room is 164 by 58 feet. The switchboard is of the familiar General Electric panel type for street railways, provided with automatic cut-outs and the usual apparatus. An excellent idea of the character of the foundations and the smooth running of the engines may be had from the fact that one of the large generators was in service when each of the views of the room presented was taken and the vibration was not sufficient to cause any loss of detail.

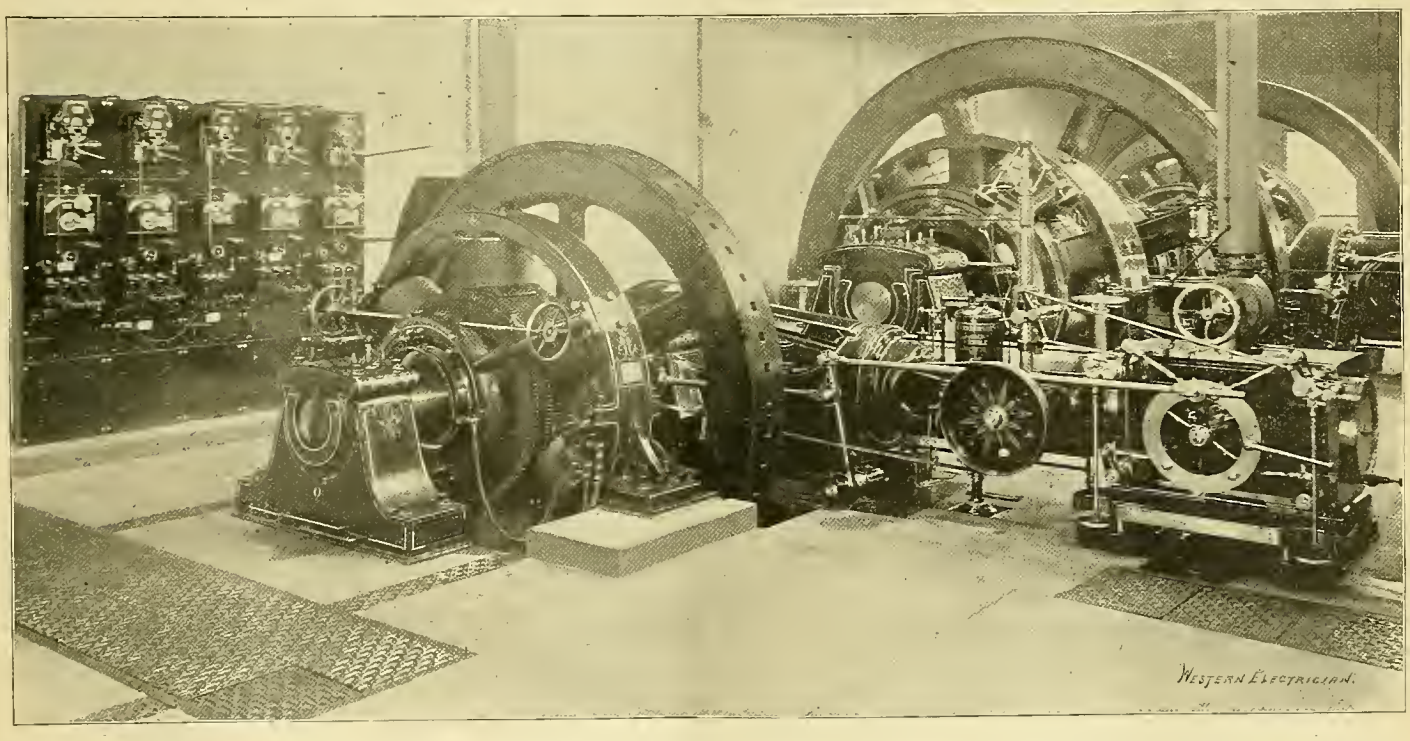



FIG. 1. ELECTRICAL EQUIPMENT OF THE CASS AVENUE AND FAIR GROUNDS RAILWAY, ST. LOUIS.

The boiler room is 164 by 50 feet and contains six return tubular draw draft boilers, arranged in pairs, and manufactured by the O'Brien Boiler Works of St. Louis. They each have 18 six-inch flues and measure 22 feet by 66 inches. A steam pressure ranging from 75 to 100 pounds to the square inch is maintained, the water being heated in an Excelsior heater. A conveyor, running along the floor in front of the furnaces, and operated by a small upright engine, carries away the ashes and loads them in wagons.

Before the adoption of electricity as a motive power the total mileage of the system was only a little over 27 miles. It now comprises about 35 miles. A rail, 85 pounds to the yard, is laid, the ties being placed 12 to the rail and the joints supported. Curve rails weigh 100 pounds to the yard. The overhead and track wiring was furnished by the General Electric company. The rolling stock of the company consists, in addition to a number of trailers, of about 70 motor cars, each equipped with two General Electric motors of 25 horse power capacity each.

During the storms of last winter an opportunity was given to make some severe tests upon the generating equipment, and records of careful readings made at the station furnish some interesting data. The following are the readings made every five minutes upon engine and dynamo No. 2 for an hour's run on January 24, 1894, the day following the great blizzard, when a great quantity of snow blocked traffic. The rating of the generator is given at 1,250 amperes at 600 volts pressure, the speed being 100 revolutions per minute.

| P. M. | Amperes. | Volts. |
|---|---|---|
| 6.15 | 2,000 | 555 |
| 6.20 | 2,600 | 550 |
| 6.25 | 1,500 | 555 |
| 6.30 | 2,600 | 550 |
| 6.35 | 2,600 | 550 |
| 6.40 | 1,600 | 565 |
| 6.45 | 2,400 | 560 |
| 6.50 | 1,200 | 570 |
| 6.55 | 1,800 | 565 |
| 7.00 | 1,400 | 570 |
| 7.05 | 1,200 | 560 |
| 7.10 | 1,400 | 560 |
| 7.15 | 1.000 | 565 |

This table is interesting as showing the great variations to which electric railway generating apparatus is subjected, and the great overloading as indicated in several instances speaks well for the efficiency of both electrical and steam machinery. During the month of March, 1894, a record was kept of the operation of the power house. The following data from this record is furnished by the officials of the company and may be accepted as trustworthy:

Average daily consumption of coal, 864 bu.
Average daily consumption of water for steam purposes, 44,100 gals.
Pounds of water evaporated by 1 lb. coal, 5.31 lbs.
Water consumed for each horse power per hour, 22.41 lbs.
Coal " " " " " " " 4 22 lbs.
Average daily run, 19 h. 30 m.
Total stops per month, none.

| | |
|---|---|
| Average daily horse power, 19 h. 30 m. | 841 |
| " motors cars daily | 69 |
| " trail cars daily | 26 |
| " daily car mileage (motor) | 123 |
| " " " " (trailer) | 62 |
| " " horse power per motor car | 15.52 |
| Pounds coal per motor car per mile | 7.76 |
| " water " " " " " | 41.25 |

An ordinance for an electric lighting franchise has been passed in Fort Dodge, Ia.

## Economical Operation of Electric Light Plants from an Electrical Standpoint.[1]

By C. K. Stearns.

The object of this paper is not so much to explain in what way electric light companies can most economically operate their plants as to discuss one or two methods which may prove advantageous to central stations. During these days every one is striving for economy, and electric light companies are endeavoring to discover leaks which, when remedied, will at least reduce their operating expenses and enhance their receipts.

New stations are putting in compound and triple expansion engines, using condensers if possible, even though the first cost is greater. Directly coupled slow speed dynamos are used to avoid the loss and annoyance of belts. Dynamos are selected of such size as will keep the separate units loaded to their maximum capacity the greater part of the time. Long lengths of shafting are avoided if possible. Heaters, highly efficient boilers, mechanical stokers capable of burning cheap grades of coal, and economizers are employed, thus utilizing all the heat possible. High insulation of the lines is demanded. Lubricating oil is filtered and used a second time. Coal is weighed, and the best quality demanded for the purpose. Everything is brought down to a system which conduces to economical operation. In fact, the manager must know what everything is costing from day to day, and in this way keep a check on his expenditures.

A great many stations keep an ampere record taken at stated intervals, and in this way form an approximate idea of what their load is during the time of operation. By the use of recording meters, preferably wattmeters, an accurate record can be kept of the output. And not only this, but the manager can form a just opinion of any excessive loss between his coal pile and the lines. Thus, knowing the amount of power put out over his lines, and knowing what to expect from his dynamos, engines and boilers, it is a simple matter to determine how much coal and water is needed. Suppose, for instance, that the station is divided into units, and we have a wattmeter on each unit, and at the end of the day's run it registers 1,000 horse power hours. Suppose also from the statement given us of the efficiency of the dynamos, engines, etc., we may expect 3 pounds of coal per horse power hour and 20 pounds of water per horse power hour, the amount of coal burned should be 3,000 pounds, and of water consumed 20,000 pounds during the run. These figures should check up with the weights given by the engineer. If they do not, there is evidently a leak somewhere, which should be investigated. By the use of recording wattmeters on each circuit, or a total recording wattmeter in small stations, this record is invaluable. Wattmeters can now be purchased which are applicable to direct and alternating circuits (either primary or secondary), and will prove a check not only to the station operation but on the outside lines.

This brings us to the discussion of supplying lights by the contract system or by meter. It seems to be conceded that with an accurate meter the most economical method for both the customer and the company is to sell on the meter system. This fact is strongly brought to our attention during the present depressed times by the number of stations which are changing from the contract system to the meter system.

I mentioned that it was economical for the customer. Under the contract system the customer naturally becomes extravagant in the use of light—in fact, he wishes to "get his money's worth." Extravagance in one line will lead to other extravagances, so I contend that although the shock to the consumer by changing from contract to meter may be severe, he is benefited in the end. From the producer's standpoint it is a benefit, as may be shown by the numerous statements of station managers. In fact, I have failed to find one who did not believe the change was a benefit to him. Under the contract system the customer uses all his lights, whether he needs them or not, and the result is your station is fitted out with a dynamo capacity equal to your maximum load, which occurs between 7 and 9 o'clock in the evening. Before 7 and after 9 your load is light and your machines are idle.

With the meter system, of course, your load will be heavy between 7 and 9 P. M., but your maximum load with the same number of customers will be at least 30 per cent. less. This statement is amply proved by the testimony of numerous stations adopting the meter system.

It is obvious that the proper time to make the change is in the summer time, when the ampere hours of each customer is at its minimum. At first the customers' bills as a rule will show a marked increase over the contract rate, and will continue so until the customer learns to burn only such lamps as are needed. It does not necessarily follow that in operating on a meter basis the individual bills will be greater, in fact in many cases it is the reverse. An investigation of stations run on the meter system shows most conclusively that they are more profitable than those operated on the contract system. The reason is simple. The lighting company saves the power which would otherwise be wasted by the consumer's extravagance. In this way the surplus power found after the change from contract to meter system can be used in extending the service.

The actual number of hours during which a consumer's lights are burning, multiplied by the number of watts per lamp, gives the consumption in watt hours for that night. Now, if the total contract rate be divided by the number of lamps used, and the result divided again by the total number of actual lamp hours of service, it will be generally found that the existing income per burning lamp per hour is surprisingly low. This condition of affairs arises not so much from the customer's monthly bills being small, as from the fact that a large amount of useless light is carried more or less constantly upon his circuits, light which is of no service to the customer, but which is none the less an expense to the lighting company.

If the meter were made the basis of charge, and the rates so placed that the customer would pay for the light really needed about what was previously paid for by contract for the wasteful service, the consumer would speedily learn to so economize as to use light only where useful, thus reducing the real consumption, while practically the same income would be received. Consumers are almost always well pleased with this arrangement because it leaves the amount of their bill entirely dependent upon their own economy, while if their lights remain unused there is no bill at all.

Further economy results from this system when lamp renewals are furnished by the lighting company, inasmuch as the life of the lamps is greatly increased by reason of the discontinuance of the wasteful burning.

I have mentioned that the record shown by the wattmeter in the station will be a check not only on the coal pile, but also on the lines. On the contract system this will form a check, but on the meter distribution it will serve as a detector of leaks in the line, every watt being recorded. Gas companies have found it necessary to use a large meter to measure the total consumption, and it is equally important in the electric light service. The sum indicated on the consumer's meter, plus the loss in distribution, plus the drop on the lines, should equal the reading of the station meter. On the alternating circuit the loss in the transformers should, of course, be taken into account, and it will show whether these losses are excessive. In this way it may be possible to so distribute your transformers that they are more nearly kept to full load, and the consequent saving made.

For commercial arc lighting recording wattmeters are made which can be relied upon, and unless your contract rates are particularly favorable much more satisfactory returns can be obtained by the use of meters than by the contract system.

The public is still skeptical regarding the accuracy of the gas meter, although the present form has been in use for the last twenty years. It is, however, a very reliable instrument; but we have electric meters to-day which are more accurate than the gas meter. Although the record of the patent office shows that this subject of electric meters has been studied for the last ten or fifteen years, there are comparatively few prominent recording ampere or wattmeters.

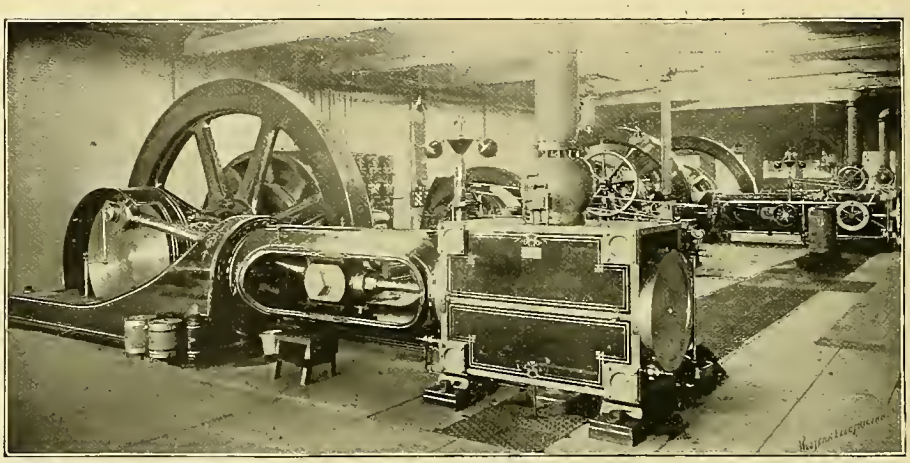


FIG. 2. ELECTRICAL EQUIPMENT OF THE CASS AVENUE AND FAIR GROUNDS RAILWAY, ST. LOUIS.

Probably the first in the field was the Edison electrolytic meter, the principle of which is the use of an electrolytic cell or cells, placed in a shunt circuit, the resistance being so proportioned that a definite fraction of the current passes through the cell. The chemical action of the meter when in use consists in depositing metal from one electrode to another, the rate of deposits being equaled by the amount of current passing through the meter. The electrical energy consumed is measured by the increased weight of the electrode which receives a deposit. This meter is undoubtedly accurate, and it is extensively used, although it has the disadvantage, from a consumer's standpoint, that he must rely upon the central station's word as to the amount of ampere hours burned. Of course he can roughly check it up by keeping a record of the number of hours he has burned his different lamps, but he is at the mercy (from his standpoint) of the lighting station. From the manager's standpoint there is considerable trouble and expense in renewing and handling the cells and acids.

The Shellenberger meter, of the motor type, is devised for alternating currents only. In this meter we have a metal armature capable of rotation; this armature rotates in two fields of force, the axis of one of which intersects the axis of the other. The armature operates a train of gears representing the revolution of the armature. To retard the speed of the armature fans or vanes are provided. The difficulty of this type of meter, which is only applicable to alternating currents, is to produce the proper speed under light load and to produce the proper retarding effect by the vanes.

The Aron meter, invented by Dr. Aron of Prussia, registers the amount of current consumed by noting the difference of the rate in movement of two clocks, one of which is affected by the passage of the electric current. The apparatus consists of two pendulums regulated so as to have synchronous oscillation. The left hand pendulum is of the usual construction; the right hand pendulum carries at its extremity a steel magnet. Each pendulum is kept swinging by a clock movement actuated by spring power. Both pendulums act jointly upon a dial train which counts the difference of their oscillations. As long as no current passes through the counter coil below the magnetic pendulum, both pendulums oscillate synchronously, and the train is at rest. As soon as current passes through the large coil, however, the time of oscillation of the magnetic pendulum is affected, so that it swings faster as the current passes through the coil, increases the dial train, registering the oscillation of the magnetic pendulum.

The degrees on the dial are multiplied by a constant obtained for each meter, to obtain the current consumed. This meter is quite expensive but accurate. It requires winding up once in 30 days.

The Walker meter registers the current by means of photography on a strip of sensitive paper operated by clock work. A line is thus marked on the sensitive paper by means of a small incandescent lamp, placed in front of the dial. The sensitive paper is developed at certain periods and the area found by means of a planimeter. The consumer cannot of course read this meter, unless equipped with the necessary appliances.

I now wish to call your attention to the Thomson recording wattmeter, a description of which is best given in the words of Caryl D. Haskins. To exactly fill the requirements a recording wattmeter should meet the following conditions: First, it should register watt hours, that is, the amount of power and not current, delivered to any circuit; second, it should be adapted to either continuous or alternating circuits; third, the instrument should be accurate throughout the entire range; fourth, it should combine simplicity of design with noiselessness and durability. The meter is simply a motor of the most elementary nature, driven by the same source of electrical energy which it is to measure and its notation during any period is proportioned to the power or watt hours delivered to the circuit during that time.

The Thomson recording wattmeter consists of a simple skeleton motor, having no iron in either armature or field. The fields, which consist of two coils, one on either side of the armature, are connected in series with the lamps or motor whose absorption of energy they are to measure, all the current in use passing through them. The armature is of the Siemens drum class, having a small commutator and brushes with contact pieces. This is in shunt across the line, like a lamp, and having a considerable resistance of fine wire in series with it, forms a pressure coil, its current varying with the voltage.

It will be readily seen, therefore, that as the field varies with the current, and the armature with the pressure, the speed of the motor will vary directly with the power or watts in use, which is of course the ideal method of measurement.

Friction would, however, seriously affect the accuracy of those results were it not compensated for. This is accomplished by taking off the armature circuit beyond the fields. Thus there is a slight constant field independent of that created by current flowing through the lamps, caused by the flow of the armature current through the field coils. On very low loads where friction is a strong factor, this "shunt" or constant field forms a comparatively large percentage of the total field and torque, thus accurately balancing the meter against the friction, while on medium and high loads both friction and the shunt fields become so insignificant a percentage of the total load and torque that their influence cannot be detected and may be neglected.

Another essential feature remains to be described, namely, the slowing mechanism, or means for loading the motor. The necessity for this retarding mechanism is too apparent to need explanation, and has been fully appreciated by all makers of recording motor meters. In the Thomson meter this is accomplished by placing on the shaft a thin disk of copper, some little distance below the armature. This disk is rotated between the poles of three permanent magnets. The fields of these magnets generate Foucault or eddy current in the disk, thus forming a considerable drag or load on the motor, which is constant and proportionate in its action.

Thus it will be seen that neglecting friction, which, as we have noted, is compensated for, the meter is proportionate throughout, for torque is directly proportionate to the product of the current in armature and fields, which equals amperes multiplied by volts—that is, torque is directly proportionate to the energy of watts passing the meter. Speed is directly proportionate to torque, and retarding effect or generation of current in disk is directly proportionate to speed. Therefore, the theory of the instrument is consistent and correct throughout.

Another good feature of the meter is that the drag or load is considerable, hence friction, the only varying quantity, forms even on light loads but a small proportion of total retarding effect. The indications of the meter are shown in watt hours on the dial gear or train, the first wheel of which engages with a worm on the shaft, thus connecting it with the revolution on the armature. The cali-

1. Read before the Northwestern Electrical association at St aul, July 19, 1894.

bration of the Thomson recording wattmeter is readily and effectively accomplished by moving the poles of the permanent magnets toward or away from the periphery or center of the disk, thus increasing or decreasing its speed till it becomes synchronous with the standard instrument.

The watt hour forms a perfect and convenient unit for measurement, being an actual unit of power, and therefore readily comparable with all other standards, as well as simple in itself. One thousand watt hours may be taken as practically equivalent to 100 feet of gas; thus the consumer, already familiar, as most consumers are, with gas practice, has a ready means of noting or checking his consumption of light.

I have given you a rather detailed description of the Thomson recording meter for the reason that it lends itself to all classes of incandescent work, both alternating and direct, for motors and railway work and arc lighting. It requires less care than other types, and by its construction is most satisfactory to both the central station and consumer.

There are other points, such as recording volt and amper meters, which would no doubt be of advantage in large stations, but which would rather be a luxury than a necessity. Time will not allow of this discussion.

FIG. 2. DESTRUCTION OF THE FACTORY OF THE SIEMENS & HALSKE ELECTRIC COMPANY OF AMERICA.

## Destruction of the Factory of the Siemens & Halske Electric Company of America.

The factory of the Siemens & Halske Electric company of America at Chicago was completely destroyed by fire on the night of August 1st. Some idea of the destructiveness of the conflagration which swept over a portion of the city's lumber district and which ruined, among others, the new factory of the company, may be gained by reference to the reproductions of photographs taken the next morning and when the debris was still smoking. The building was substantially built of brick and was located in about the center of the burned-over lumber district. It is difficult to present an accurate estimate of the total loss sustained by the company, for much valuable machinery was in process of construction and the power plant of the factory was delivering current for the operation of the electric road upon West Twenty-second street. It is roughly estimated, however, that the total damage may be placed at about $300,000. The insurance carried was only about $110,000. One loss which is to be particularly regretted is that of the generating machinery intended for the street railway company at Toronto, Ont. This apparatus was to have been of great capacity and size, and the spider of one of the generators, shown in the WESTERN ELECTRICIAN of June 30, 1894, is said to have been the largest in the world. Considerable of this machinery was in a completed condition and was about to have been delivered. A view of the ruins of the machine shop, showing the armature stars or spiders of these machines, as well as those of several others in process of construction, is shown in Fig. 1. The electric crane used for moving the heavy parts of machinery may be seen in the background, half buried in the piles of what is now nothing but rubbish. Fig. 2 presents the scene from another location and is one which comprises a view of the entire property of the company burned, including the boiler plant. It may be regarded as curiously fortunate that the only portion of the factory left standing is a small space containing the vaults and safes of the company. These were broken into after the fire had destroyed everything around them, and the books and valuable drawings were found to be comparatively uninjured. The machine patterns were isolated in a fireproof building a short distance from the main building and although its iron doors were smoking the next day, its contents were preserved.

Immediately upon receipt of the news of the work of the fire, the other large electrical companies in this country offered the Siemens & Halske company all the assistance in their power. After such a complete destruction of its property it is not to be expected that the company could come at once to a decision regarding its plans for the future further than that it was resolved not to cancel its contracts, but to proceed upon the construction of the machinery. In addition to this apparatus designed for the Toronto Street Railway company, the generators for which were of 1,200 kilowatt nominal capacity, the company had only last week secured the contract for the electrical equipment of the lines of the West and North Chicago Street Railway companies, as announced exclusively last week in this journal. The contract calls for three 2,000 horse power and one 1,000 horse power generator and specifies that the first dynamo shall be completed within four months of the award of the contract and that an additional machine shall be completed every 15 days. The West Side power house is designed to ultimately accommodate five 2,000 horse power generators and one of 1,000 horse power, and the North Side station will eventually contain generators aggregating 6,000 horse power. It will be seen from the magnitude of these contracts that work must be commenced immediately; and as the company announces that it will furnish the machinery as per contract and that it is taking smaller contracts upon 90 days' delivery, it is presumed that it will soon be possible to announce the plans of the company. In this connection it has been rumored that advantage may be taken of the inactivity of the plant of the Grant Locomotive Works. The Grant Locomotive company failed June 6, 1893, and at that time its plant was scheduled as worth $857,000. Offers from other concerns for factory room have also been made and a decision will speedily be arrived at.

It is a source of great regret among electrical men that the Siemens & Halske company should have been compelled to be handicapped by the loss it has just sustained. The design of the electrical machinery manufactured by the company is of acknowledged merit, and during the time the company has been selling its products in this country it has made a satisfactory reputation as a producer of electric light and street railway apparatus. The name of Siemens & Halske, from its association with the great European house of that name, is a dignified one and commands attention not only owing to the fact that its machinery upon general lines is similar to that of the Berlin house, but because of the record it has already made in this country. At its head are men who will not be dismayed, but who will undoubtedly, on the contrary, continue to establish the reputation of the firm for efficient machinery and business-like methods.

FIG. 1. DESTRUCTION OF THE FACTORY OF THE SIEMENS & HALSKE ELECTRIC COMPANY OF AMERICA.

## Association of Edison Illuminating Companies.

The annual convention of the Association of Edison Illuminating companies will be held at Boston, commencing on Tuesday, August 14th, and continuing through Wednesday and probably Thursday of that week. The headquarters of the association during the convention will be at the Vendome, where the sessions will be held and where arrangements have been made for delegates on the American plan for board and outside room, without bath, at $4 per day and board and inside room, with bath, at $4 per day.

Reports of committees chosen at the meetings of last year will be made and the following papers of practical importance submitted by the gentlemen named:

Incandescent Lamps, A. D. Page.

The Relative Advantages of Direct and Alternating Currents for Distribution of Light and Power, W. S. R. Emmet.

A Board of Control, Prof. Wm. D. Marks.

An Edison Station in a Small City, Its Past, Present and Future, M. A. Beal.

Switchboard of the Edison Company of New York, J. Van Vleck.

Storage Batteries, R. R. Bowker.

Boiler Tests in Atlantic Avenue Station of the Edison Electric Illuminating Company of Boston, R. S. Hale.

Interesting Features of the Third District Station of the Edison Electric Illuminating Company of Boston, A. G. Pierce.

Low Tension Arc Street Lighting System, W. S. Barstow.

The Edison Electric Illuminating company of Boston, of which C. L. Edgar is vice-president and general manager, has arranged a very attractive programme for the entertainment of delegates in the form of drives through the beautiful suburbs of Boston. Visits will also be made to the West End station of the Boston street railway system, and to the Edison stations in Boston, where can be seen the latest type of central station equipments, including the recently installed central station storage battery, now in successful every-day operation.

The General Electric company will have present one or more of its officers and engineers, with a view of having them become personally acquainted with the different members of the association and of discussing matters of general interest. The company has extended an invitation to the members of the association to visit the Lynn works and join them in a dinner at Marblehead Neck, the great rendezvous for all yatch club races.

During the convention sessions a special entertainment will be provided for ladies accompanying members. The Edison Electric Illuminating company of Boston has provided entertainment for all members who may find it possible to reach Boston on Monday evening. It is thought advisable, after considering the experience of previous conventions, to devote the first two days strictly to the business of the asso-

ciation, with as short recesses as possible, leaving the third day entirely free for pleasure trips.

The programme for the convention provides for reports of committees and addresses at the first session beginning Tuesday, August 14th, at 10 A. M. The second session, beginning at 2 P. M., will be devoted to papers, discussions and addresses. On Wednesday, August 15th, there will be an early morning drive through the suburbs of Boston, beginning at 8 A. M. The third session at 11 A. M. will conclude the business. It will be devoted to papers and discussions, followed by the election of officers. On the last day, Thursday, August 16th, there will be a visit to the West End power station and the stations of the Edison Electric Illuminating company of Boston, followed by a trip to Lynn and entertainment at Marblehead.

## Whitney Electrical Instrument Company's Factory at Penacook, N. H.

There is no more interesting branch of the electrical business than the delicate work of manufacturing instruments for measuring the strength, pressure and variation of the electric current. It is very creditable to the knowledge and skill of American electricians and mechanics that the United States should possess the reputation of producing instruments of precision of this character second to none of the best German and French appliances for accuracy and for delicacy of adjustment. One of the concerns that has done its share in contributing to this source of national pride is the Whitney Electrical Instrument company, whose factory at Penacook, N. H., was recently visited by a representative of the WESTERN ELECTRICIAN and is illustrated by the accompanying pictures.

The establishment is located amid beautiful surroundings on the banks of the Contoocook river. The buildings are well adapted to the class of work turned out and consist of a main factory three stories in height, with ground dimensions of 50 by 100 feet, and a boiler house and office in a one-story addition 30 by 60 feet. The rooms are all large, light and airy, with large windows on four sides, giving abundant light, which is, of course, an important requisite in fine work. The various departments are well supplied with all the necessary mechanical equipment, although, as will be readily conceived, intelligent workmanship is the most important factor in the manufacture of electrical instruments. The views presented in Figs. 1. and 2 give a good idea of the work carried on in the different rooms. They show the machine and calibrating departments, a glimpse of the office and corners of the battery and shipping rooms, with two examples of electrically driven machinery. Beside these there are wood-working and plating rooms.

All the direct current instruments are tested by means of a storage battery equipment, which contains over 500 cells charged by an Eddy generator. This battery is also used to light the shops whenever the machinery is not running. There is also a 100 volt direct current dynamo designed and built by Dr. A. H. Hoyt, which is used for lighting. The alternating current instruments are tested directly from the dynamo up to 1,000 volts, while above that a step-up transformer to 5,000 volts is used.

Dr. Hoyt, the manager and electrician of the company, is the designer of all the instruments now made by the concern—ammeters, voltmeters and potential indicators. He is now perfecting a new instrument for the measurement of alternating currents. One of these was placed in a circuit of 16,000 alternations per minute and readings taken. Then the current was changed to 6,000 alternations per minute and no change could be detected. The instrument was then placed in a direct current circuit, and the reading was within one-tenth of one per cent. The instrument is new and novel in construction and will soon be offered to the public.

The company is now making ammeters for direct and alternating current which read down to $\frac{1}{1000}$ of an ampere, while the larger ones indicate up to 4,000 amperes and are guaranteed to be accurate to ½ of one per cent. The voltmeters and indicators are built in all sizes and for all uses—laboratory, station or private—and are accurate and durable. Several instruments for the big three-phase alternating station at Sewall's Falls are now building and will go on a 3,000 volt circuit. It may also be mentioned that the establishment is provided with ample facilities for the manufacture of delicate electrical apparatus and that a specialty is made of repairing, correcting or standardizing instruments of other makers.

The standard potential indicator is illustrated by Fig. 3.

## Electricity in Insurance Matters.

William S. Boyd has been appointed assistant electrician for the Electrical Bureau of the Chicago Underwriters' association. The work of fitting up the laboratory in the Insurance Patrol building on Monroe street, adjoining the Woman's Temple, is progressing rapidly, and the work of making tests of various electrical apparatus will begin shortly under the direction of William H. Merrill, Jr., the electrician. The appropriation for its maintenance only became available on August 1st.

## Electric Railways in Chicago.

It is announced that the North Chicago Electric company and the Chicago Electric Transit company will commence the construction of their lines in a short time, mortgages amounting to $1,000,000 and $2,000,000 having

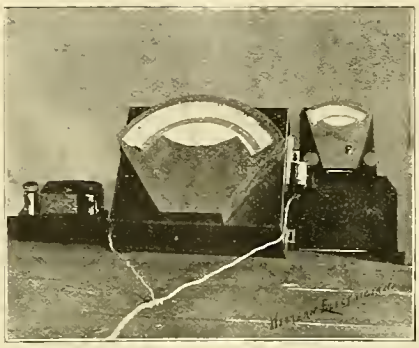
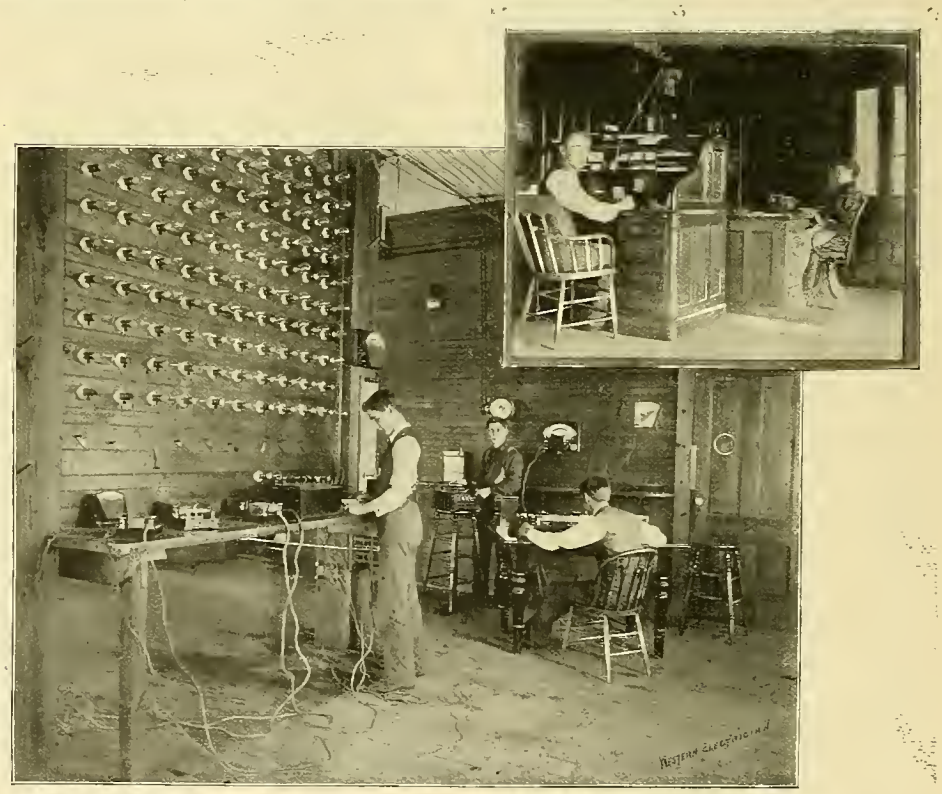


FIG. 3. STANDARD POTENTIAL INDICATOR OF THE WHITNEY INSTRUMENT COMPANY.

been placed upon the property of the respective companies. It is given out by the general management of the two roads that the contracts will be let at once. The $3,000,000 for which the mortgage was given on the two electric lines will be used in constructing them on the routes assigned to them, as well as other feeders which may be found necessary to connect with the Northwestern "L," which will be utilized as the trunk line for the rapid transit system for the North and West Sides proposed by the owners of the allied lines. A mortgage to the amount of $15,000,000 was filed a week ago Wednesday upon the property of the Northwestern Elevated Railroad company. The negotiation of the $15,000,000 loan, D. H. Louderback announces, is for the construction expenses of the road, which will be built by the Columbia Construction company, which is capitalized at $2,000,000, 50 per cent. of which has been called in. Mr. Louderback has secured a certified copy of the Lake street "L" extension ordinance for examination by the recent purchasers of that property, and while no definite information can be had on the subject, it is generally understood that the ordinance, with the mayor's amendments, will be accepted. Of course the "L" road on Lake street and that known as the Northwestern, which so far exists only on paper, being practically under the same control, will join together in seeking common terminal and loop facilities downtown. As to the kind of power to be used on the Northwestern Mr. Louderback has nothing to say in addition to what has already been published in this journal. It has been given out that Mayor Hopkins has stated that electricity will be used exclusively on the new "L," and that he even quotes Mr. Louderback as his source of information on this subject.

The proposed scheme for the construction of a down-town electric elevated railroad loop to be operated in connection with the various elevated roads will be presented to the City Council for consideration at the opening session immediately after the summer adjournment is at an end. The company back of the scheme was incorporated only lately, but was considerably talked of during the agitation relative to a down-town loop early in the spring. The company has the rather broad and extensive title of the Chicago & Suburban Electric Elevated Railway company. The prospectus issued gives the object of the company to build an electric elevated railroad in the city and suburbs, but first of all, to secure the necessary frontage consents for the loop for the elevated roads already in existence, as required by law. The latter is stated as the principal object of the company. The route of the loop is in the very center of the city. It is intended to be placed on Randolph street, beginning at State, thence west to Market, thence south to Jackson, thence east to State, thence north to Randolph to the point of beginning. This route will reach the Lake street, the Northwestern, and the Metropolitan elevated roads, and the company figures that the South Side Alley road can reach it by extending down the alley to Jackson street. The company makes the statement, however, that in case the route is not satisfactory to the majority of the roads intended to be accommodated by it, it can be changed as may be deemed more satisfactory. Mayor Hopkins is reported to think favorably of the plan projected by the Chicago & Suburban Electric Elevated Railway company. It is said that although he has given the scheme no thorough study, he thinks if the elevated roads can be given a down-town loop on terms that are fair and reasonable to the city the proposition is worthy of consideration.



Calibrating Room. Office.

FIG. 1. WHITNEY ELECTRICAL INSTRUMENT COMPANY'S FACTORY AT PENACOOK, N. H.

The North Chicago Street Railway company has asked the Commissioner of Public Works for a permit to erect electric trolley poles on Lawrence avenue from Evanston avenue to Clark street, and on Addison street between Lincoln and Southport avenues.

The Englewood & Chicago Electric Street Railway company expects to have its main line to Morgan Park completed within three months. This is to be one branch of the company's system of 45 miles of road. When it is finished the residents of Morgan Park, Longwood, Fernwood, Roseland, Burnside, Dauphin Park and Englewood will be able

to ride to Sixty-third and Vernon avenue, where the line connects with the Alley "L" road. A portion of the line from Sixty-third street on Vernon avenue to Sixty-seventh street was opened a week ago Wednesday. The power-house for the main line will be at Vincennes road and Eighty-seventh street, and, with equipments, it is said will cost $100,000. The electric line will be operated by a trolley system, with center poles. The capital stock of the company is $1,000,000 and the bond issue is $2,500,000.

## Incandescent Lamp Litigation.

On August 1st Judge Seaman of the Circuit Court of the United States, Northern District of Illinois, filed the following opinion at Chicago in the case of the Edison Electric Light company and the Edison General Electric company against the Star Electric Lamp company, David J. Kennedy, Albert S. Terry and Franklin S. Terry:

This hearing is upon a rule to show cause why an injunction *pendente lite* should not issue against the defendants according to the prayer of the bill of complaint.

The rule was entered, with a temporary restraining order, June 9, 1894, when the bill was filed alleging infringement of letters patent No. 223,898, issued to Thomas A. Edison, January 27, 1880, for an incandescent lamp. The validity of this patent is not questioned here, and for the purposes of this motion at least must be taken as well settled by repeated adjudications.

Infringement is unquestioned if the patent is alive with reference to the defendants.

The only defense is that which was set up and maintained recently in the Circuit Court for the Northern District of Ohio, in the case of the Edison Electric Light company against the Buckeye Electric company (59 Fed. Rep., 691) viz., that the complainants are estopped from asserting, as against these defendants, that the patent extends beyond November 10, 1893, because a purported amendment in the Patent Office, dated December 18, 1883, appears to limit its existence to the term of a "British patent for fourteen years, dated November 10, 1879." It is undisputed that this amendment did not correctly show the date from which the British patent took effect, that the proceeding was taken under a mistaken view, and was not within the jurisdiction of the Patent Office, that it was expunged on March 13, 1893, and adjudications have settled that it was void and did not limit the term of the patent.

The opinion by Judge Ricks, in the case cited, shows careful consideration in holding an estoppel, and taking it in connection with two subsequent opinions by the same learned court, whereof certified copies have been furnished for this hearing—one upon reconsideration of the former case, after further showing, re-affirming the first decision, and the other, in a case of the same complainants against the Universal Electric Company, distinguishing and explaining the prior decisions, and holding the estopple not applicable, because the defendant "began business as an infringer" and made its further investments "after the revocation of March, 1893", would be strongly persuasive of a similar ruling for the purpose of this motion, if analagous situations of the parties and facts are shown.

The defendant, the Star Electric Lamp company, is a recent incorporation, having legal existence only from March 18, 1893, which would be subsequent to the cancellation in the Patent Office of the alleged amendment of the patent.

Within its own rights, therefore, it is clear that this corporation is barred from any of the benefits of estoppel which might arise in favor of one taking action and making large investments before the cancellation.

It would be ruled by the case of the Universal Electric company, last cited, and the well-settled principles there announced.

But the defendants contend that this corporation is simply an outgrowth and continuation of another corporation, the Sunbeam Incandescent Lamp company, or, as stated in their brief, is "a mere creature of the Sunbeam company," having the same officers, stockholders and managers, and "is in fact the same company under another name," and being founded upon "the same investment and interest," is entitled to any benefits of estoppel which would work in favor of the parent company.

This statement may well be accepted as true, in the identity of stockholders, management and investment, but the two companies have nevertheless separate corporate entities.

Whether this identity of interests would enable the defendant corporation to draw to itself any benefits of estoppel which may have existed in favor of the Sunbeam company, or whether the individual defendants, who are made parties as officers of the Star company, could avail themselves of any such defenses vesting in the Sunbeam company, does not require decision here, because I am clearly of the opinion that the Sunbeam company deprived itself of that defense, if it ever existed.

The Sunbeam Incandescent Lamp company was organized in February, 1890, and made considerable investments for the manufacture of incandescent lamps, and entered upon their manufacture.

Certain of its stockholders received by mail a notice from attorneys of complainant that the courts had sustained the Edison patent, and that infringers would be vigorously prosecuted, but with this notice was a copy of the patent, accompanied by the certificate of amendment of December 18, 1893, and relying upon this as limiting the term of the patent to November 10, 1893, further investments were made.

On January 14, 1893, the complainants filed a bill against the Sunbeam company and its officers for infringement of the patent, and obtained a temporary restraining order, but the hearing upon a rule to show cause why the injunction should not continue *pendente lite* was postponed from time to time until May 17, 1893, when an agreement was entered into between the parties reciting infringement by the Sunbeam company, their desire to avoid litigation and damages and necessity to complete about 150,000 lamps then in process, and license was thereupon given the complainant for that purpose, upon terms specified and accountings to be rendered. It was agreed by the Sunbeam company that upon the completion of the lamps referred to "it would refrain from manufacturing infringing incandescent lamps during the life of the patents," their validity was admitted and consent stipulated to a decree in the action against the defendant company "as prayed for in the bill of complaint."

The complainant waived all costs, damages and profits.

The manufacture under this agreement has continued, with accountings as provided for, and is still progressing. On October 2, 1893, the final decree was duly entered with perpetual injunction, but the individual defendants, Kennedy and Terry, were dismissed from the bill, pursuant to an understanding to that effect explained by affidavits as intending that there should be no interference with the manufacture of non-infringing lamps designed by them in which gas was substituted for a vacuum.

The defendants claim that they entered into the agreement in the belief, founded on the amendment, that the "life of the patent" would terminate November 10, 1893, although it is admitted that complainants then asserted otherwise, and their bill of complaint, on which the stipulation and decree were entered, alleged a right for seventeen years from the date of the patent.

It is significant, also, that the answer of the defendants in that case, filed May 8, 1893, made no defense or assertion of this estoppel, which if well founded would have terminated any right to an injunction before final hearing could possibly be reached.

This agreement bound the corporation and its officers and stockholders for all interests and rights which were there involved; all prior rights and equities must be held merged in it to the extent imported by its terms.

Any belief which may have been entertained by either of the parties relative to the duration of the patent cannot prevent the operation of the settlement for the actual life of the patent as therein expressed; it leaves the extent to be determined according to the fact and not upon any estoppel which might have been invoked before the settlement.

This is a clear case for the application of an estoppel against an estoppel, which "setteth the matter at large," as stated by Lord Coke, Branson v. Wirth, 17 Wall., 32.

If, therefore, the showing made by the defense would primarily have constituted an estoppel in favor of the Sunbeam company through investment by its stockholders in reliance upon it—which is not here decided—that company was foreclosed by its agreement and acts and the defendant corporation, which is masquerading here as a new company, with all the interests of the old one, cannot take the benefits of the old without the attendant burdens.

The complainant shows clear right to protection by an injunction *pendente lite*. The fact that the defendants have a large investment in a plant which will be rendered idle by an injunction cannot be permitted to turn the scales against a case so made out.

The individual defendants are properly made parties as officers of the corporation—president, treasurer, and secretary respectively—and, while an injunction against the corporation is binding upon its officers, it is proper to name them in the order or decree. The history of this litigation shows the value of such practice.

An injunction will issue against all of the defendants according to the prayer of the bill.

---

A central lighting station will soon be operated in Williamsport, Ind., by the Falls Electric Light company. A 30 kilowatt 1,000 volt Thomson-Houston alternator and a 30 light arc machine will constitute the electrical equipment.

## The Corrosion of Iron Pipes by the Action of Electric Railway Currents.[1]

By D. C. Jackson.

The foundation of this paper is an investigation carried out under my direction by Paul Biefield and Fred D. Silber at the University of Wisconsin. I have incorporated the report of their experiments directly into the paper as far as possible. Their work was divided under two heads: First, to determine what chemical action really occurs under the conditions that are met in towns where corrosion of the water and gas pipe systems have occurred through the action of electric railway return currents. Second, to examine the action which has actually occurred in various towns, apply the deductions gathered from the results of the first division of the work, and determine the best methods of avoiding difficulty or danger from corrosion.

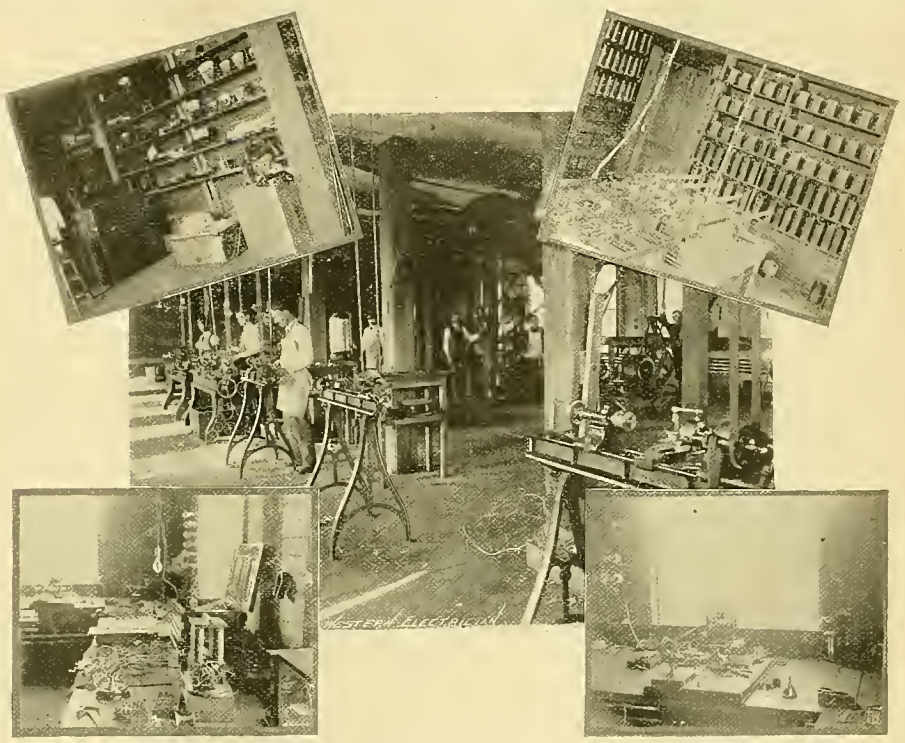
About two years ago engineers of the West End Street Railway company of Boston began to connect the reinforcing wire laid between the tracks to the water pipes, anticipating little or no trouble from so doing. They soon found that the supplementary wire was destroyed in places. They first attributed this to chemical action of the soil, but finally concluded that it was due to electrolytic action. As a remedy they reversed the polarity of their generators, sending the current out through the rails and back through the overhead trolley wire. This change was followed by disastrous results. The current, pumped through the rails, took to the water pipes and lead cable coverings, according to the law of divided circuits, and leaving these at many points along the line, caused serious corrosion at these places. It was found that lead pipes at some points disappeared inside of six or eight weeks and galvanized iron and brass pipes deteriorated noticeably in an equal time.

After a conference between representatives of the city and the railway company, it was decided to go back to the old way of current distribution. The direction of the current was therefore reversed, and careful tests were made, which showed that considerable current flowed along the water pipes. So great in fact was this current that the arc formed at a joint where oakum was used for calking was sufficient to set fire to the oakum. This loss of pressure on the return circuit was found to be from 25 to 100 volts, or from 5 per cent. to 20 per cent. of the total pressure. As an experiment the water system was connected to the negative pole of the dynamo, and now a new danger was found in the difference of potential between the gas and water pipes, causing a marked electrolytic effect on the former. It was then proposed to connect the gas and water pipes together in all parts of the city in order to arrest the action, and this was done with fair results. The expense to the city and the company was great, and the final solution of the difficulty was far from satisfactory to either party.

The report of the Board of Commissioners of Electric Subways of Brooklyn for 1892 briefly referred to the same trouble as of uncertain character and extent. Since then the problem has become very serious in Brooklyn on account of the growth of the electric railways in that city, and the same report for 1893 calls attention to the fact that discoveries of corrosion have been numerous enough to justify the belief that all kinds of buried pipes are being eaten away in many places. As an example may be cited the fact that a certain iron service pipe buried at a depth of four feet below the track had been completely perforated in a month. In Brooklyn, as in Boston, connection between the return circuit and the corroded service has been tried with some success. The means for preventing the action in Brooklyn is as yet in an experimental stage, so that proposed extensions

[*Continued on page* 67.]

1. Read before the Western Society of Engineers, July 11, 1894.



Shipping Room. Lathe Driven by Motor. Machine Shop. Battery Room. Lathe and Grinder.

FIG. 2. WHITNEY ELECTRICAL INSTRUMENT COMPANY'S FACTORY AT PENACOOK, N. H.

Western Electrician.

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IN the train of modern scientific and industrial achievement has come a number of new physical ailments—the price that civilization appears to be called upon to pay for its advancement. Electricity is credited with two or three of these recently diagnosed disorders, and physicians are now paying more attention than ever before to the effect of the electric current and electric phenomena on the human body. Just now, in France, some of the doctors are endeavoring to find a remedy for what has borne the clumsy and misleading name of "electric sunstroke." This modern affection frequently befalls workmen employed in factories where metals are fused or welded by the arc process. The light produced during the period of connection is of course intense, and even at a distance of thirty feet the rays produce a painful, hot, pricking sensation, like that of a burn on such uncovered portions of the body as the throat, face and more especially the forehead. The skin of the parts affected is said to become either copper-colored or assumes a bronze hue; the eyes, in spite of black glasses, are so intensely dazzled as to be useless for some minutes, after which anthopsia or yellow vision sets in, everything appearing saffron-colored; the conjunctiva are inflamed and there is a gritty feeling as of sand under the eyelids; there is frequently considerable pain, also sleeplessness and in some cases fever. The physicians have discussed the effects of the blinding flash with much learning, but have as yet proposed no better remedy than that which would naturally suggest itself to any layman—perfect rest in a subdued light. So long as the voltaic arc is employed in metal working it is not likely that any means will be discovered to prevent occasional temporary injury to the eyes of the workmen.

AN excellent list of papers has been prepared for the Boston meeting of the Association of Edison Illuminating Companies, and it is to be expected that they will be fully and freely discussed. It is to be regretted, however, that the policy of the association excludes from participation in the proceedings such members of the fraternity as are not directly interested in Edison companies or members of the organization. Moreover, it has been the practice of the association to give out only such portions of the proceedings for publication and general circulation as would be of little interest, suppressing the most important papers and any discussion that might be of value to the general public. Much regret will be felt by those who are not admitted to the Boston meeting, if the paper and discussion on "The Relative Advantages of Direct and Alternating Currents for Distribution of Light and Power" are not published. It seems as if the association in this instance might profitably depart from the policy heretofore followed. It would certainly prove a popular movement with the electrical fraternity generally, and no doubt a majority of the members of the organization would be glad to avail themselves of an opportunity to exchange views with the experts representing other than Edison interests. To-day many Edison central station companies are successfully operating alternating apparatus as well as direct current machines. The views of managers of such stations on this topic are particulary desirable, and it is to be hoped that the association will take a liberal view of the matter and permit the publication of at least this paper and discussion.

IN granting an injunction restraining the Star Electric Lamp company from manufacturing, selling or using incandescent lamps that infringe the Edison patents, Judge Seaman last week ruled that "the fact that the defendants have a large investment in a plant which will be rendered idle by an injunction cannot be permitted to turn the scales against a case so made out." The defendants had raised the point that the complainants were estopped from asserting that "the patent extends beyond November 10, 1893, because a purported amendment in the Patent Office dated December 18, 1883, appears to limit its existence to the term of the 'British patent for fourteen years, dated November 10, 1879.'" It has been decided that the term of the United States patent was not so limited, and Judge Seaman holds that the defendant is barred from any of the benefits of estoppel within its own rights on account of the fact that the date of its formation, March 18, 1893, was subsequent to the cancellation in the Patent Office of the alleged amendment of the patent. The claim made by the Star company that it was successor to the old Sunbeam company—"in fact, the same company under another name"—and, therefore, entitled to the privileges of that corporation in this proceeding, is set aside. The court ruled that the new company had a separate corporate entity. Aside from this the judge expresses the opinion that the Sunbeam company had deprived itself of the right to set up this defense by reason of an agreement with the owners of the Edison patent, which bound the Sunbeam company, its officers and stockholders, to refrain from continuing in the business of manufacturing infringing lamps.

IN a carefully prepared report on electrical sanitation C. W. Chancellor, United States consul at Havre, discusses the experiments conducted in that city, Rouen, L'Orient and other French towns by M. Hermite in treating sewage by electrolysis. He says that "in spite of the several objections which have been urged against the system, it is believed by many who have witnessed its application that M. Hermite is engaged in an enterprise of great pith and moment, and that electricity may yet be made as useful to man as a shield against death by preventible disease as it has already proved itself a priceless servant as a messenger and an illuminant." The question of expense will of course form an important factor in the problem. Many experts who have watched the French experiments, while admitting the disinfecting properties of the electrolyzed sea water, or mixture of sodium and chloride of magnesium, have expressed some doubt as to whether the liquid could be produced in sufficient abundance and at a sufficiently cheap rate for large towns, including the sewers and streets to be irrigated with it. At Havre, where there is an unlimited supply of sea water, the question of economy has not been satisfactorily settled. It is urged, however, that the application of the system would have the advantage of saving a large proportion of the water usually employed for the flushing of soil pipes and drain pipes, as well as the much larger quantity employed in flushing sewers and washing gutters. How far this would compensate for the expense of the plant would largely depend upon the value and quantity of water ordinarily used. The commission of experts appointed by the municipal council of Havre to investigate the Hermite system gave considerable attention to this feature. From a financial view point the commission reported that the results obtained showed that it cannot be considered an economical process, but that it would require further study and experiment before it can be recommended as applicable to large cities. The success of the system from a sanitary view point was satisfactorily demonstrated to the commission, and this of itself is encouraging and will no doubt lead to renewed efforts on the part of those engaged in the work to so improve and simplify the process as to make it an economical as well as a scientific success.

WHILE the war in Korea attracts renewed attention to the great value of the ocean cables which connect that portion of the world with Europe, and hence with the United States, comes the account of a great jubilee celebration held in the Imperial Institute, London, on July 20th, to mark the twenty-fifth anniversary of the establishment of submarine telegraphy with the far East. Sir John Pender, chairman of the Eastern and Eastern Extension Telegraph companies, presided, and the fete was a very elaborate one, the various incidents covering a period of nearly eight hours. At the banquet the company numbered nearly 500, while the reception was attended by about 5,000 guests, and a party of about 60, including the royal visitors, was entertained in the fellows' dining room. The company was a brilliant one, including the Prince of Wales and other members of the royal family, the United States ambassador and representatives of other countries, Lord Kelvin, General Wolsely, the lord chancellor, the secretary of state for India, Sir Charles Tupper, the Canadian commissioner, Prof. Ayrton, Prof. Crookes, Prof. Fleming, Prof. Hopkinson, Lord Morris, Lord Playfair, W. H. Preece, General Roberts, Sir D. Salomons, Prof. S. P. Thompson, Sir Richard Webster and other distinguished persons.

Mr. Bayard, the United States ambassador, made an eloquent speech, which was marred, however, by a reference to the possibility of preventing the battle of New Orleans had an Atlantic cable existed eighty years ago. That battle resulted in a great victory for American arms, and as the British were the aggressors, both sides being in ignorance of the fact that peace had been declared, Mr. Bayard did not represent the spirit of his countrymen in allowing the felicitations of a festal occasion to cause him to make an observation on General Jackson's signal triumph that might be considered as apologetic.

There was an exhibition of telegraphic apparatus, outdoor music, promenading about the grounds and abundant decorations. The celebration was skillfully planned, and not marred by accident. We hope that before another quarter century is completed the United States will be the scene of a similar gathering to signalize the completion of a direct Pacific cable to Australia and Asia.

PROF. JACKSON'S contribution to the discussion of the question of underground electrolysis in cities due to single-trolley railway systems, as presented in the paper on "The Corrosion of Iron Pipes by the Action of Electric Railway Currents," which is given in this issue, will give comfort to those who contend that a practicable remedy can be found by a properly connected rail return circuit. "I am quite confident," he says, "after carefully studying many cases of corrosion and applying the conclusions of these experiments, that there are very few places where the difficulty cannot be avoided by proper construction and arrangement of return circuits. This can ordinarily be none at a comparatively small expense and with a resulting advantage to the operation of the railway." Farther on the author describes the plan he favors as follows: "Connecting the pipes and rails with heavy cables at points where the former are positive to the latter proves the most complete method of prevention. The conductivity of the track's circuit must be properly reinforced by feeders so that an undue drop is not experienced in the return conductors. These track feeders should always be insulated and put on the lines exactly as are overhead feeders, in order to save them from corrosion. The connection of pipes and rails has been practically carried out in Milwaukee, Wis., at a cost of about $8,000, and has apparently done away with the trouble, and has at the same time decreased the resistance of the return circuit." Prof. Jackson is an engineer of practical experience, and his opinion is of value, but we are far from certain that his plan will meet the situation. To "properly reinforce" the track circuit by buried insulated feeders will entail upon the railway manager an expensive and harassing system of underground conductors that would very likely prove a constant source of trouble and annoyance in a large equipment, making the remedy worse than the disease. Prof. Jackson does not believe that it will be necessary to revert to the double-trolley system, but we are inclined to the opinion that railway companies would prefer it to the elaborate "proper construction" of single-trolley lines which he advocates.

## The Corrosion of Iron Pipes by the Action of Electric Railway Currents.

[*Continued from page 65.*]

of the railway system along the line of one of the largest water mains in Brooklyn is regarded with anxiety.

Milwaukee has also had her share of trouble from the same cause. O. M. Rau, electrical engineer of the Milwaukee Street Railway company, tells about it in an article in the *Street Railway Review*, in December, 1893. At two feet from the power house on Wells street a six-inch water main was so badly corroded after the electric railway had been operating for four years as to render it entirely useless. When taken out of the ground it was so soft in places that a cane could easily be poked through it. In Milwaukee the corrosion was arrested by making numerous low resistance connections between the pipes and rails, thus keeping the two at the same potential. The connection is made most secure at the pipe station, where both pipes and rails are led to the negative pole of the generator by heavy cables. It is found that as much as twenty-eight per cent. of the total output is now returned by means of the pipes and no difficulty is encountered. The plan has been working very satisfactorily for over a year.

The Chicago experiences have been set forth in a report made by Prof. Barrett to Mayor Harrison in June, 1893. The destructive effects in Chicago are apparently entirely similar to those of the cities above mentioned. In Prof. Barrett's report some experimental work is referred to, in which a current of .3 ampere, continued for three weeks, was most destructive to a lead telephone cable, while a cable which was buried in the same soil but was not subjected to the action of the current was unaffected.

In Zanesville, O., a four-inch cast-iron water main was completely perforated in two years. All the neighboring pipes were affected, some of them lasting only six months.

Columbus, O., Hamilton, Ont., Indianapolis, Ind., Philadelphia, Los Angeles, Cala., and many other cities where considerable electric railway systems are in operation have experienced the same difficulties. In every case the corrosion has exhibited the same general features and pointed to the same cause.

It is now practically agreed that the reason for the extraordinary corrosion which is referred to here is to be found in the character of the return circuit of the electric railways. When electric railways were first constructed the rails in connection with the surrounding earth were relied upon to carry all the current back to the generator. It was soon discovered that the current would not confine itself to this path and that the resistance of the earth was far from being as low as was originally supposed. Bonding the rails, cross-bonding, supplementary wires and ground plates were then tried. The last were found to be of little avail, while the copper bonds and supplementary wires were often themselves electrolyzed, and bond wires up to the present time have frequently been far too small in cross-section for the large current to be carried. The tendency which now obtains is to make the return circuit of fully as great conductivity as that of the overhead supply circuit, without relying upon any conductivity from the ground. This is being accomplished by effecting the rail-bonds and running heavy track feeders, or electrically welding the rails. There is little doubt that with a perfect return system, which is properly connected to systems of underground pipes, electrolytic disturbances will practically disappear in nearly all cities.

Though the corrosive action of the return current has been so frequently noticed and commented upon, no one has really determined what actually occurs in the ground under the conditions brought about by the operation of electric railway systems. Two theories have been put forward relative to the corrosion: First, that it is simply due to chemical action caused by ammonia, saltpeter, leakage from gas mains, etc., found in the earth; second, that it is the result of electrolytic action. While simple chemical action undoubtedly has much to do with shortening the life of a pipe, it cannot on the face of it produce effects of the magnitude of these noted above. The ordinary life of water and gas pipes where chemical action alone is met is said to be about 20 years, while the corrosive action with which we are dealing has destroyed new pipes in intervals having from a few weeks to half a dozen years' duration. In every case of the corrosion to which we refer an electric current has traveled along the pipe, and the corrosive action has taken place at the point where the current left the pipe. This is conclusive proof of electrolytic action. Secondary chemical reactions play an important part in the final decomposition of the pipe, and these are dependent upon the character of the salts in the soil, but the current sets the ball rolling. The electrolytic action of the current may occur by means of two processes—(1) direct electrolysis of iron and (2) electrolysis of chemical compounds which are held in the water of the soil, setting up secondary chemical reactions at the electrodes. In order to have electrolysis at all it is necessary to have the equivalent of an electrolytic cell. In the case of a current leaving a pipe at any point, the pipe is the anode or positive plate of such a cell, the waste of the soil containing the chemical compounds in solution is the electrolyte, and the rail is the cathode or negative pole of the cell. All corroded iron pipes taken from the earth present practically the same appearance. They are generally "pitted" in many places, and although the pipe is covered with a layer of reddish oxide, the bulk of the corroded metal has generally been entirely carried away in some form or other, presumably by a secondary chemical change.

In order to have the first electrolytic action go on (that is, direct electrolysis of iron), a soluble iron salt must be present in the soil, reaching from anode to cathode. The analysis of street soils shows no such salts, and hence we are safe in concluding that this factor does not enter into the corrosion to any practical extent. The point has been made by several writers on the subject that the phenomenon may be due to the electrolysis of water, the nascent oxygen set free at the anode attacking the iron directly, and forming iron oxide. An examination of the facts of electrolytic action shows that this is not an effect of practical magnitude. This leaves us but one hypothesis to work upon—that is, the electrolysis of substances held in solution in the water of the soils, with a resulting secondary chemical action on the pipes.

In order to determine as exactly as possible what occurs in the soil due to the return current, a series of laboratory experiments were performed, in which the practical conditions were reproduced as fully as possible.

Almost every chemical analysis of street soils shows the presence of some soluble salts of ammonia, potash, soda, and because of their common occurrence an experiment was performed to determine the effect of these salts on the electrolytic corrosion of iron plates per ampere hour. Six small electrolytic cells were run in series under an electric pressure of about 100 volts, with a current varying from .2 to .04 ampere. The cells contained clean glass sand moistened with water containing the salts.

Cell 1 contained $NH_4NO_3$. (Nitrate of ammonia.)
" 2 " $NH_4Cl$. (Chloride of ammonia.)
" 3 " $KNO_3$. (Nitrate of potash.)
" 4 " KCl. (Chloride of potash.)
" 5 " $NaNO_3$. (Nitrate of soda.)
" 6 " NaCl. (Chloride of soda.)

After a run of 14¼ hours the number of ampere hours was .7465.

Loss of anode of $NH_4NO_3$ cell pr amp. hr. was .921 gramme.
" " " " $NH_4Cl$ " " " " 1.314 grammes.
" " " " $KNO_3$ " " " " 1.887 "
" " " " KCl " " " " 1.346 "
" " " " $NaNO_3$ " " " " .729 gramme.
" " " " NaCl " " " " 1.299 grammes.

It had been shown by previous experiments upon cells containing these salts that iron was carried off from the positive plates but was not deposited on the negative plates. The deposit of iron was made in the form of a layer of hydrate or hydroxide of iron near the middle of the cell. The same was true of experiments made with cells containing street soil where only a comparatively small percentage of carbonates was present. This explains the remark often made in reports of the corrosion of pipes that the products of the corrosion had disappeared. It was noticed during the experiments that all the cells containing a nitrate gave off a gas at the anode, and this, on being collected, was found to be oxygen. The same cells showed an acid reaction at the anode when tested with methylorange, and the reaction grew less in intensity as the current decreased. In cell No. 1 of the series already referred to, this acidity failed to show itself when the current fell to .6 ampere; in cell No. 3 at .045 ampere, and in cell No. 5 it was very faint at .04 ampere when the current was shut off. The acid reaction and the escape of oxygen in these cells seemed to be associated, and here it becomes necessary to refer to the losses of the anodes in the different cells. It will be seen that the chloride cells exhibit the greater losses, while the nitrate cells show the smaller. Moreover, the cell containing a nitrate in which the formation of acid and oxygen ceased first shows the greatest anode loss, and the one in which it continued to a slight degree to the end of the experiment shows the least. These facts point very strongly to the soundness of the theory of the corrosion which has been finally worked out; namely, in an electrolytic cell with iron electrodes and a soluble salt or salts of the metals of the alkalies or alkaline earths in solution in the electrolyte the salt is electrolyzed by the current, the acid radical attacks the anode, forming an iron salt, while the alkaline metal forms with water a hydroxide at the cathode liberating hydrogen there. Finally, the meeting by diffusion of these two products precipitates ferrous hydroxide (FeOH). As the amount of electrolysis varies with the strength of the current, a comparatively high current will liberate the acid radical more rapidly than it can combine with the iron, the critical point depending upon the affinity of the acid for iron. When this excess is present, the radical forms an acid by combining with water and at the same time liberates oxygen. Neither the acid nor the oxygen can combine with the anode because that is already engaged in the formation of an iron salt with the acid radical, and hence the gas escapes into the air. If the acid is formed in sufficient quantity, it diffuses through the electrolyte, meets the alkaline hydroxide and forms the original salt and water. In the case of chlorides, the nascent chlorine liberated at the anode, forms with it a chloride of iron, and if the current is strong enough to form an excess of chlorine it will be dissolved in the water and may, under the influence of light and heat, form an acid and liberate oxygen; or, if enough heat is generated, free chlorine will be given off, as is shown by experiment. All conditions of these laboratory experiments are practically parallel in the earth, and hence it is safe to say that similar chemical reactions must go on there. Although the composition of street soils is more complex than the electrolytes of these experiments, they contain the same soluble salts, and as these are diffused through the moist earth they must lend themselves to exactly similar electrolytic influences and chemical changes. In fact where street soils were used in the experiments as the electrolytes of cells which were placed in series with cells containing known quantities of simple and mixed soluble salts, the losses of the anodes were entirely comparable. It is consequently seen that only such measures as will stop the electrolytic action on salts in solution in the soil can be relied upon to stop the corrosion of iron pipes.

The soil frequently contains carbonate of calcium and magnesium, which are dissolved by virtue of the carbonic acid in the water. When carbonates are present in the water to a considerable degree a reddish layer of iron carbonate is found on the pipe. This is generally mistaken by observers for oxide of iron, but we have never found the latter present as a result of electrolytic corrosion. To find the effects of carbonates upon the corrosive powers of soils we ran four electric cells in series. The first two had for electrolytes glass sand moistened with a ½ per cent. solution of chloride of soda in distilled water, and the other two had the same electrolyte with the addition of a solution of carbonate of of magnesia and carbonate of lime of uncertain strength. The latter solution was obtained by passing carbonic acid for 1½ hours through water containing equal parts of these carbonates in suspension. The test current was kept at .09 ampere for 7 hours, making .65 ampere hour.

The average loss of the anodes of the cells containing chloride of soda alone was .6565 gramme, while that of the carbonate cells was .601 gramme. This makes it evident that the presence of the carbonates does not aid in the corrosion of the anode, and even the slight cathode loss, due probably to ordinary oxidation, is less in these cells than in those containing the chloride only. The difference in the losses of the anode is easily explained. In some previous experiments the loss of anode caused by the electrolysis of a nitrate, a chloride, and a mixture of the two was compared. The chloride caused the greatest loss of anode, the nitrate the least, and the mixture caused a loss between the two. In the same way in the case of the carbonate and the chloride, the chloride caused a certain loss of anode, and when mixed with carbonate the loss is somewhat less than when the electrolyte is a chloride alone. The fundamental effect of the carbonates is shown by a further description of the experiment. Soon after the current was turned on the chloride cells began to show the formation of the ferrous hydroxide layer between the electrodes which has been previously spoken of while the other two cells showed a reddish layer formed at the anode, spreading toward the cathode as the action progressed. The reddish layer consisted of carbonate of iron, which was formed by the action of the carbonates upon the products of the electrolysis.

The results of many experiments and the condition of corroded water pipes as observed leaads to the conclusion that under the conditions existing in street soils the corrosion will primarily go on by virtue of the acid radicals of the hydrochloric, nitric, sulphuric and other acids, the carbonates held in solution by virtue of the carbonic acid acting merely to change the ferrous salts, to the normal iron carbonates and the ferric salts to the ferric hydroxide. Should the carbonates in solution be electrolyzed in addition to the salts of the alkaline metals, the carbonic acid radical would not attack the iron, as the corrosive power of the other acids is so much greater, but would again form with the ferrous salts the iron carbonates.

Owing to the doubt which exists as to what minimum voltage is required to induce electrolysis of water pipes by the railway current, a series of determinations was made by means of the electrolytic cells. The iron electrodes were inserted in clean glass sand 1.5 centimeters apart, and had about 20 square centimeters exposed area. In the first cell a 1 per cent. solution of nitrate of soda was used with a voltage of .2. As before, the hydroxide layer was formed. The electrolytic action was plain without any other tests. In the following cells the existence of action was shown by chemical tests for the iron salt and the alkaline hydroxide. In the second experiment, a ⅓ per cent. solution of nitrate of soda was used with 5 volts. The action was at once apparent.

| | | | |
|---|---|---|---|
| Cell 3. | Pressure .25 volt. | Action in | 3 min. |
| " 4. | " .125 " | " " | 5 " |
| " 5. | " .125 " 1-6 per ct. sol. | " " | 5 " |
| " 6. | " .05 " " " " | " " | 40 " |
| " 7. | " .013 " " " " | " " | 50 " |
| " 8. | " .005 " " " " | " " | 1 hour. |

In cell 8 the hydroxide layer began to be apparent after one hour.

Cell 9. Pressure .001 volt 1-6 per ct. sol. Action in 1 hour.
" 10. " .01 " Action in 4 hrs. 45 min.

Cell 10: The electrodes were 20 mm. apart and were 40 mm by 68 mm. in exposed surface. The electrolyte was street soil.

A surprisingly low voltage produced an appreciable electrolysis in the sand cells. The pressure on cell No. 10 might undoubtedly have been reduced to a millivolt without stopping the corrosion, but the resistance of the soil was so high and the percentage of soluble salts so low that the time necessary to produce action would have been considerable. A milliammeter showed a barely perceptible reading in the case of the experiments in which very low pressure was used. The observations plainly show that a mere directive force is necessary to produce electrolysis, and the corrosion is simply a question of current.

It is impossible to give in a reasonable space even a summary of the great number of experiments which were made, but the following conclusions are directly drawn from them:

1. In no case is the action due to the electrolysis of water; where oxygen is liberated at the anode it does not attack the iron.

2. Only a mere directive force in the nature of a pressure will cause electrolysis.

3. The actual corrosion is therefore only dependent upon the actual current which flows, and is as much dependent upon the resistance of the soil as upon the pressure tending to cause the current.

4. Only a minute quantity of soluble salt is sufficient to start the action, and it will then continue as long as a current flows.

5. The gravity of a corrosion of a pipe depends on the amount of current flowing from a given area and the nature of the salts present in the soil, the order of the activity of the salts being (1) chlorides, (2) nitrates, (3) sulphates.

The following table gives the average loss of iron from the anode per ampere hour, due to different salts and mixtures of salts. It must be remembered that the cathode or negative pole in no case showed a gain, but generally showed a slight effect due to simple oxidation.

| Electrolyte— | Loss per ampere hour. |
|---|---|
| Street soil from a certain place | .8 gramme. |
| " " " Madison Electric Ry. route | 1.16 " |
| " " " " " " " (clay) | 1.14 " |
| " " " in front of Madison power sta | .91 " |

| | 1 gramme. |
|---|---|
| Sand with $Na_2SO_4$ | .66 " |
| " " $KNO_3$, ½ per cent. solution | 1.03 " |
| " " $NH_4Cl$ " " " | 1.38 " |
| " " $KNO_3$ " " " | |
| " " $KH_4Cl$ " " " mixed | 1.084 " |
| " " $NH_4NO_3$ | .921 " |
| " " $NH_4Cl$ | 1.314 " |
| " " $KNO_3$ | .887 " |

| | | |
|---|---|---|
| Sand with KCl | 1.346 | gramme. |
| " " $NaNO_3$ | .729 | " |
| " " NaCl | 1.299 | " |
| Average loss of chloride cells | 1.335 | " |
| " " " nitrate cells | .892 | " |
| " " " sulphate cells | .660 | " |

One ounce is equal to about 28½ grammes.

The averages emphasize the fact that the chlorides produce the greatest losses of metal, nitrates coming next, the sulphates last, the mixtures in an intermediate place. This seems to show that the power of the acid radical to corrode varies in general as the activity of the corresponding acids.

In I. H. Farnham's paper on "The Destructive Effects of Electrical Currents on Subterranean Metal Pipes," which appeared in the "Transactions of the American Institute of Electrical Engineers" in April, 1894, the statement was made that when the current was reversed every minute extending over a period of ten days, no material change took place in either during that time. Our experiments have shown that only the positive plate or anode is affected by the electrolytic action which occurs under practical conditions, and hence we should expect that when the current is frequently reversed both plates will be corroded, since they are alternately positive, unless the frequency of reversal is too rapid for chemical action to occur at all. In order to ascertain the effect of such reversals the following experiments were performed: An electrolytic cell was run containing a weak solution of nitrate of soda. The period of reversals ranged from fifteen seconds to five minutes, the current flowing being .04 ampere under a pressure of three volts. After a few of the quarter-minute reversals, the presence of the iron salt was detected at both plates of potassium ferricyanide tests. On prolonging the periods the iron reaction diminished at one plate and increased at the other during the same period, and *vice versa* in the following period. When the period of reversal reached 2½ minutes the electrolytic effect was very evident; the iron salt disappeared at one of the plates with each reversal, giving way to alkalinity. The experiments showed that the minimum period of reversal during which corrosion goes on must lie below fifteen seconds, which makes the prevention of corrosion by reversals entirely impracticable from this cause alone.

The problem of preventing the destructive electrolytic effects upon iron pipes of the railway return current is shown to consist simply of the prevention of electrolysis of the salts in the soil when the products of electroiysis are of such a nature as to attack iron. It is a problem that requires a careful study of the local conditions in each case before it can be satisfactorily solved. I am quite confident, however, after carefully studying many cases of corrosion and applying the conclusions of these experiments, that there are very few places where the difficulty cannot be avoided by proper construction and arrangement of return circuits. This can ordinarily be done at a comparatively small expense, and with a resulting advantage to the operation of the railway. Some of the conditions that exert the most marked influence upon the corrosion are the nature and amount of the soluble salts in the earth, the resistance of the earth itself in the locality, and the electrical pressure between rails and pipes. High pressure differences do not necessarily imply a high degree of action, as is shown by the condition of the Madison water pipes. Here, as much as seven volts is found between the rails and the pipes in front of the power station, and yet only a very small amount of corrosion is shown after 1½ years' time. Evidently the resistance of the path here must be very high or the quantity of soluble nitrates, chlorides or sulphates is extremely small. The fact that a special and ingenious instrument made to measure the amount of current showed but .0003 ampere flowing leads to the former conclusion. On the other hand, with the favorable conditions of a low resistance path between the pipes and rails and a relatively large amount of soluble salts in the earth, there is no doubt that serious electrolytic effects may be produced where a quite small difference in pressure exists between the pipe and rails. The extent of the railway system does not always offer a guide to the destructive influences of the return current. Mr. Farnham, in his paper previously referred to, mentions a small road in Rockland, Me., where much damage was done to pipes in five months, while the system in Madison, which is probably fully as extended, shows up to date (a period of nearly two years) a barely appreciable action.

The use of alternating currents; which produce no appreciable electrolysis, would avoid all difficulty, but their use for driving street railway motors is not, up to the present time, an assured success.

The use of a double trolley system of conductors would also avoid the major portion of the difficulty, but I believe it can be equally well avoided by proper construction where the usual single trolley systems are used. This is not a question which has a real bearing upon the discussion of single versus double trolley systems. If single trolley systems were really well built, less talk of double trolley systems would be heard. One great advantage of double trolley construction lies in the absolute certainty of its failure if the insulation of the lines is not excellent. Connecting the pipes and rails with heavy cables at points where the former are positive to the latter proves the most complete method of prevention. The conductivity of the track circuit must be properly reinforced by feeders so that an undue drop is not experienced in the return conductors. These track feeders should always be insulated and put on the lines exactly as are overhead feeders, in order to save them from corrosion. The connection of pipes and rails has been practically carried out in Milwaukee, Wis., at a cost of about $8,000, and has apparently done away with the trouble, and has at the same time decreased the resistance of the return circuit. In the Milwaukee system there is about 125 miles of track and over 200 cars in daily operation. The track circuit was originally put down in excellent shape. In the Madison system present indications show that one connection between rails and pipe systems opposite the power house, costing all told about $15, would prevent any serious action. Investigations have shown that when the negative pole or the generator is connected with the trolley, the pipes are positive to the rails over an extended outlaying district, and corrosion goes on over a large area, while with the reversed arrangement the dangerous area is concentrated about the power station. The latter method of connection allows the difficulty to be most easily handled, and after the district within which the pipes are positive to the rails has been accurately determined by proper voltmeter tests, frequent connections of pipes and rails should be made within its limits. This can usualy be done at a comparatively small cost, the interest on which may be annually saved by the decrease of lost power if the connections are properly placed. The boundaries of this district should be rechecked from time to time, and the corresponding changes in connections should be made, if the tests show that they are necessary. The outlines of the "danger district" are likely to vary with the growth of the system, and even change slightly with the seasons, and the connecting wires may be eaten away; so that vigilance is here as everywhere the price of safety, but safety may be absolutely secured in most cases.

Proper tests with a satisfactorily arranged voltmeter, such as was used in testing the Madison road, seem to give sufficient indications of the density of the current which is leaving the pipes at any exposed point. Such tests, when reinforced by chemical examination of the soil, probably may be used with advantage in determining the extent of the corrosive action which is occuring at any point.

I have not touched upon any argument in regard to the really serious corrosion which has sometimes occurred from other causes than electric railway return circuits. This is a matter which is now generally understood, but is of less magnitude in most cases than the electric corrosion. The owners of pipes are often at fault from the fact that they have filled the soil with electrolyzable salts, but even in that case they may generally avoid danger by proper co-operation with the railway companies.

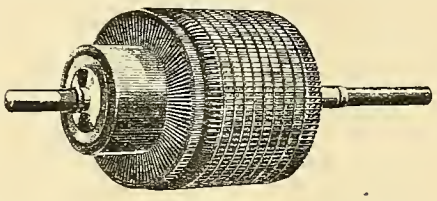


FIG. 2. IMPROVED MATHER MULTIPOLAR GENERATOR.

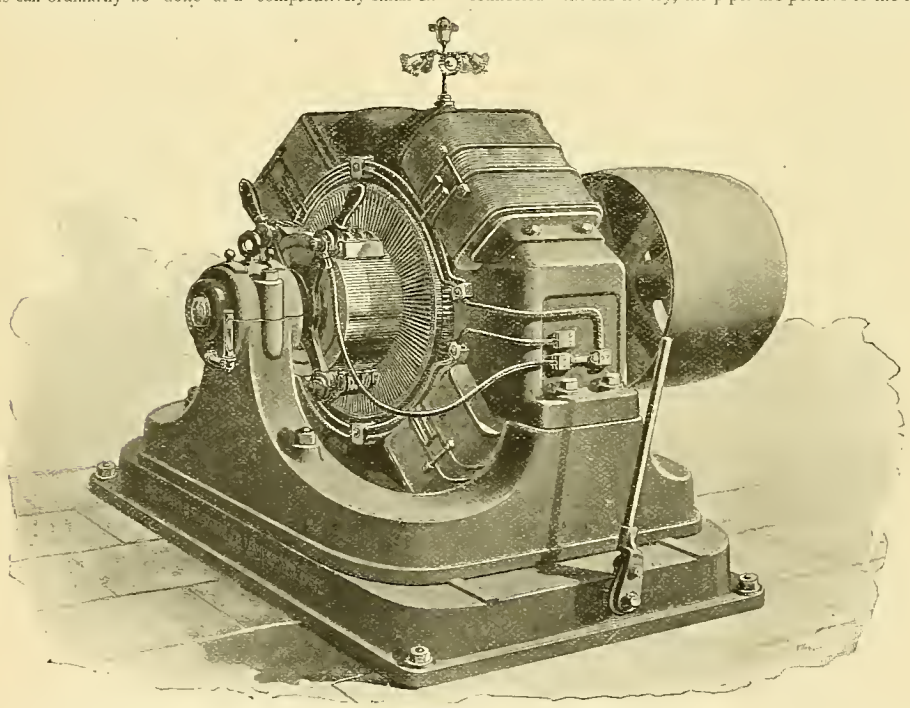


FIG. 1. IMPROVED MATHER MULTIPOLAR GENERATOR.

## Improved Mather Multipolar Generator.

In the accompanying illustration, Fig. 1, is presented a view of an improved Mather multipolar generator of 250 horse power capacity. The electrical efficiency of these generators is exceedingly high, owing to their peculiar design and construction. One advantage of this type of generators is that on account of the fields being cast in four pieces and entirely separate from the frame, all being bolted together, the assembling or taking apart of the generator to allow the removal of the armature is accomplished in an exceedingly short time. The generators of the type illustrated are designed to be belt driven or directly connected to the shaft of the engine, and, being reversible upon their bed-plates, can be run in either direction at will by making a slight change in the connections. They are self-oiling self-exciting and self-regulating. The Mather multipolar generators are all compound wound and equally well adapted for electric lighting, electric railway or power purposes. The railway generators are wound for a nominal voltage of 500, but having a rheostat in the field circuit, the potential can be raised to 600 volts without undue heating, and the company claims that even 50 per cent. overloads will be borne for short periods without injury to the machines. The supports for the bearings and the entire bed-plate are cast in one piece, a construction which gives great strength and rigidity to the bearings and secures the greatest possible freedom from vibration. There are four sets of brushes used on the generators. Each brush is held in an independent holder, hence any single brush can be raised from the commutator without disturbing the others and, having its own spring, may be perfectly adjusted. The diametrically opposite brushes are of the same polarity and are connected. The rocker arm of the brush holder is of rigid construction and the different parts are perfectly insulated. It is designed so that it will adjust all the brushes simultaneously.

One of the distinctive features of the Mather generator is the construction of the armature, Fig. 2, which is of an improved type. The core is built up with thin disks of soft iron, which are forced together under pressure and rigidly keyed to the shaft. The greatest care is taken in the insulation of the armatures. Before winding there is fitted into each slot a carefully made mica duct, through which the wire is wound. No wires having a large difference of potential are adjacent to one another. The necessary voltage is secured by revolving a comparatively small number of coils of wire in a powerful magnetic field, rather than by using a large number of coils and a weak field. The field consists of four steel castings, which are rigidly bolted together, and which, in turn, are bolted to the cast-iron frame or bed-plate. The exciting coils are compound wound on metal bobbins, which can be readily slipped on or off by loosening a few bolts and raising one of the field castings. In the building up of all commutators nothing is used but superior drop-forged pure lake copper bars. Great care is taken in the insulation of the commutators, which are noticeable for their exceedingly massive and substantial construction. The Chicago office is in charge of J. Holt Gates, Monadnock building.

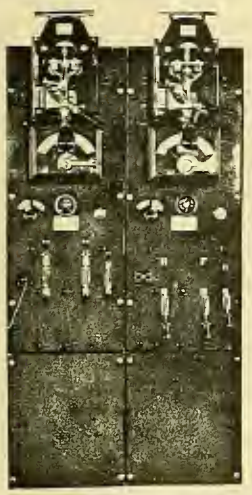
## Standard Paint Company Wins a Suit.

The Standard Paint company, New York, announces the close of its litigation to establish the validity of the United States patent under which this company has manufactured its insulating paper known under the trade name of P. & B. paper, since its organization. The United States Circuit Court for the District of New Jersey on July 5, 1894, rendered a decree in the case of the Standard Paint company against Henry J. Bird and James L. Reynolds, in which it is adjudged that the assignors of the company were the first persons to produce a paper coated with the solid residuum of petroleum, and combining the characteristics of an odorless, water, acid, alkali and air-proof paper, and that the patent under which the company has hitherto manufactured was valid and had been infringed. The court holds that any paper possessing the same essential characteristics and produced by the coating with any material similiar to that employed by this company, by whatever name it may be called, is an infringement of the Standard company's patent, and that the patent is good and valid in law. The court made a decree giving the company a permanent injunction against

the defendants in the action referred to, and directing that an accounting be had to ascertain and determine the damages to complainant by reason of the infringement. The litigation of the company has covered a period of over four years and has been attended by large expenditure and losses incident to this and other infringements.

## General Electric Company's Switchboards.

Admitting that the switchboards of electrical railway stations may be of uniform construction, handsome in appearance, and generally a credit to the station, the General Electric company's generator panel, illustrated, is worthy of notice. Briefly, the system of switchboard construction, while becoming greatly simplified, is rendered very compact and convenient. All the instruments necessary for the control of each generator are mounted together on an incombustible base and are electrically connected before leaving the factory. Each panel may be erected in position without difficulty or delay. Being of uniform size it may be bolted by the side of other panels already in place, and the switchboard extended as the capacity of the station increases without taking away from its uniformity. These new standard panels are known as type K, and are constructed in capacities of from 200 to 3,000 amperes, corresponding to the generator outputs of from 100 to 1,500 kilowatts. The controlling devices mounted upon each panel are the circuit breaker, current indicator, rheostat, main field and lighting switches, together with the lightning arrester and cut-outs required for the protection of generator and instruments. A double pole plug switch allows of connection with either a portable or station voltmeter placed in some convenient position. The panels of from 200 to 1,000 ampere capacity are of the same width and height, and in the latter dimension are similar to the feeder panels. The illustration shows two panels of 400 amperes each. The automatic circuit breaker is intended to relieve the generator



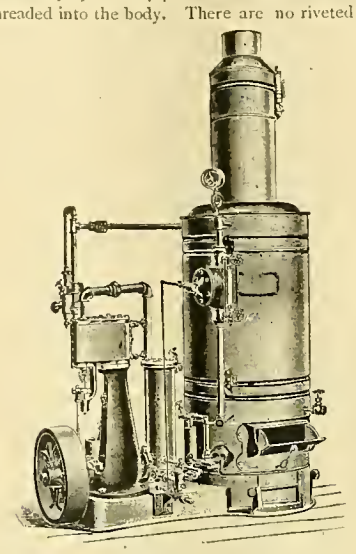
GENERAL ELECTRIC COMPANY'S SWITCHBOARDS.

of the severe strain caused by short circuit. The tripping armature is fitted with an adjustable spring which the circuit breaker can be set to open at any desired point within the range of the instrument. The current is nominally carried through a main contact in shunt to a contact operating within a magnetic blow-out. Thus when operating no arc occurs at the main contact. This circuit breaker will effectually rupture any short circuit, however severe. The armature is provided with a scale 18 inches long, which may easily be read at a distance. The positive and negative main switches and the station lighting switches, all of the quick break type, are mounted on the panel, the equalizing switch being mounted on a pedestal near the generators. In the lighting arrester the special feature is an ironclad electric magnet, in the field of which are two carbon points slightly separated, the line and ground each being connected to one of these points. The magnetic blow-out principle as in the automatic circuit breaker is here employed with unvarying reliability. The incombustible controlling rheostat is placed behind the board and is operated by a hand wheel shown on the front. The generator terminals are connected by a small four point plug switch with an illuminated dial voltmeter mounted on an adjustable bracket fastened near the top of the panel. The panels are supported by vertical angle irons, tie rod and brackets. They are wired complete, and after setting in place it is only necessary to connect the leads from the generators and bolt in place the bus bars which run horizontally back of the switchboard.

A special election is to be held in Alexandria, La., to vote upon the proposition to provide water works and an electric plant for the city.

## Racine Engine and Boiler Outfit.

The Racine engine and boiler outfit, illustrated in the accompanying cut, is a complete power plant for small users. It includes the Racine automatic quick generating safety boiler with a combination fire-box for burning wood, coke, coal, etc., in connection with oil or gas. The boiler is of the "porcupine" type and is safe under high pressure, owing to the use of only small tubes of best material. It is a quick steam maker and is compact and durable. The body is of heavy hydraulic pipe with ends welded in and the quills threaded into the body. There are no riveted seams



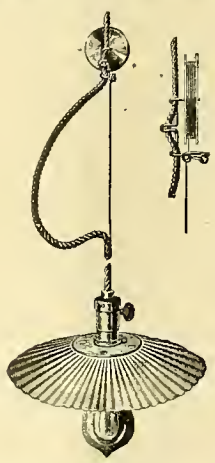
RACINE ENGINE AND BOILER OUTFIT.

to cause leakage, and it is practically impossible to explode it. There is no cast-iron about the boiler.

The engine is of the Racine automatic type, with all the latest improvements, which with the boiler is set on one base. The outfit has a feed water heater, air pump, fuel atomizer, automatic water feed regulator and water pump with all necessary fittings, such as pipes, etc., to make it complete. This outfit requires no brickwork of any kind. This combination is very economical, the engine running from 350 to 500 revolutions per minute. The company manufactures and carries sizes from one to six horse power in stock, so that prompt shipments can be made. W. F. Parish, Home Insurance building, Chicago, is the general sales agent.

## Condition of Charles H. Rudd.

In the last issue of this journal the announcement was made of an unfortunate explosion which occurred July 31st at the stone quarries of Dolese & Shepard, near Hawthorne, Ill., in which three men were killed and several others, including Charles H. Rudd, an electrical expert of the Western Electric company, severely injured. Mr. Rudd, who is well-known in electrical circles, was making experiments with a powerful explosive called Rudd-



CUTTER'S CORD ADJUSTER.

ite, one of his inventions, which it was intended should be exploded by the aid of electricity. A small plant had been set up in the quarries and it was in this building that the accident occurred, and at a time when Mr. Rudd and his assistants were in the building together. The three men who were killed were not employed by the Western Electric company, and it may be said that it was through no carelessness or lack of precaution upon the part of the company that the unfortunate circumstance happened. Mr. Rudd was taken to the Presbyterian Hospital in Chicago. He was badly burned about the face, neck and hands, and fragments of the explosive substance were embedded in several portions of his body. Last Monday the report from the hospital was not encouraging, and it was feared that blood poisoning would set in.

## Northwestern Electrical Association.

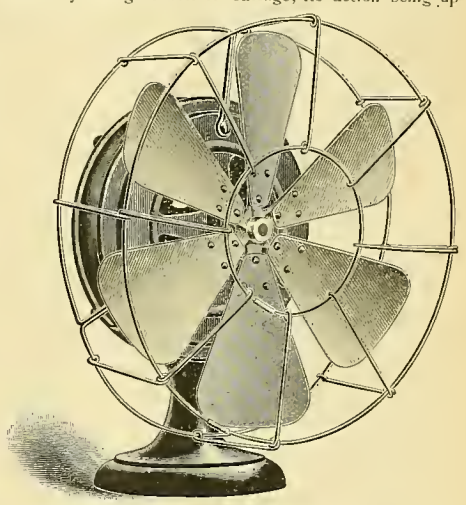
An idea of the growing interest in the Northwestern Electrical association may be gained by glancing at the list of members recently admitted to the organization. The following list of applicants favorably passed upon at the St. Paul meeting is furnished by the secretary:

Eward Daniell, Menominee, Mich.; H. B. Morgan, Chicago, Ill.; H. A. Patton, Eau Claire, Wis.; E. H. Gille, St. Paul, Minn.; W. B. Sanford, Pipestone, Minn.; Arthur S. Hully, St. Paul, Minn.; J. H. Harding, La Porte, Ind.; Charles S. Cook, Chicago, Ill.; Charles S. Marshall, Chicago, Ill.; J. G. Pomeroy, Valparaiso, Ind.; John R. Markle, Chicago, Ill.; M. J. Sullivan, Chicago, Ill.; Charles E. Gregory, Chicago, Ill.; F. E. Donohoe, Chicago, Ill.; H. O. Woodruff, Sioux City, Ia.; Fred De Land, Chicago, Ill.; Loren W. Burch, Chicago, Ill.; Charles Cuna, Oconomowoc, Wis.; J. G. Robertson, St. Paul, Minn.; William E. Rentfrow, Washburn, Wis.; R. E. Brown, Mankato, Minn.; W. P. Fitch, Mason City, Ia.; G. M. Newton, Sparta, Wis.; J. Stedman, Chicago, Ill.; St. Paul Gas Light company, St. Paul, Minn.; Electric Engineering company, Minneapolis, Minn.

## Cutter's Cord Adjuster.

In spite of the variety of automatic cord adjusters now on the market, the number in use is quite small. These are somewhat expensive and rather bulky, some being fully as large as the lamps and shade whose height they adjust. In some cases the drop cord has to be disconnected from the socket before the adjusting device can be put on.

A demand has sprung up for an adjuster which would be small and neat, and which could be quickly slipped onto the drop cord without the use of any tools. Such a form is offered by George Cutter of Chicago, its action being apparent from the illustration. It will take up about three feet of slack in the cord, enough to meet all ordinary requirements, and holds the lamp securely in any position. The device is neat and nicely nickeled.



GENERAL ELECTRIC COMPANY'S ALTERNATING FAN MOTOR OUTFIT.

## General Electric Company's Alternating Fan Motor Outfit.

The General Electric company has just perfected the fan motor outfit shown in the accompanying illustration, which is small and compact, and is constructed for alternating current circuits of 52 or 104 volts. The armature or moving part is a solid metal wheel hung on one bearing. It has no wires, no brushes, no commutators, no collecting rings, in fact no contact parts at all to cause trouble. The current from the transformer enters only a number of stationary field spools which are entirely enclosed and protected. The fan is 10 inches in diameter, has six blades and is protected by a polished brass guard. It starts as soon as the current is thrown on and runs at 1,800 revolutions, giving quite a powerful and cooling breeze. The height of the motor and fan over all is only 12 inches. It is finished in black japan on a broad stable base.

## Rapid Transit Company for Boston.

The incorporators of the Boston Elevated Railroad company, which prpposes to construct an elevated road in Boston in accordance with the opinion expressed by the people in a recent election, met last week for organization. The following named directors were elected, although this does not complete the board: General Charles A. Whittier, New York; Thomas W. Hyde, Bath, Me.; Willard Howland, Chelsea, Mass.; J. V. Meigs, Lowell, Mass.; Theo. W.

Meyers, New York; J. H. O'Neil, Boston, and George H. Towle, Boston. The directors met and elected the following named officers: President, General Charles A. Whittier; vice-president, George H. Towle; clerk of corporation, Fred C. Patch; treasurer, George A. Carney, Lowell, treasurer of the Lowell Institution for Savings; general counsel, Willard Howland; chief engineer, J. V. Meigs; consulting engineer, General Herman Haupt; executive committee, Messrs. Whittier, Towle and Hyde. An electric system is favored by the company.

## Electrical Sanitation.

The subject of a consular report recently filed at Washington is the process of sanitation by electrolyzed sea water, according to M. Hermite's plan, and the investigations on this line conducted at Havre by a technical commission appointed by the municipal council. Following is an abstract from the report which will give a general idea of Consul Chancellor's conclusions:

This so-called system is based on the electrolysis of sea water. The electric current is used to decompose the chloride of magnesium, while the chloride of sodium serves as a conductor. The result is a liquid disinfectant of great power, which is almost odorless, leaves no residuum when used for purposes of flushing, and is said to be inoffensive. It is further claimed that the solid organic matters in sewage are consumed or dissolved in this liquid, leaving an odorless fluid, incapable of fermentation, and containing only a few phosphates, the salts of ammonia, and the salts of the disinfectant. The action of the liquid on germ life is peculiar. In an address delivered at the Hotel de Ville, Havre, on the sanitation of the city, M. André Dubosc, the eminent savant, gave a very clear explanation of the way in which microbes are destroyed by the Hermite liquid. He said: "Microbes may be divided into two great classes—anaërobic organisms, which exist without air, and aërobic organisms requiring air to live. On the anaërobes, or microbes living without air, the action of the compound of chlorine is simple, as the freeing of its oxygen causes their instant death, inasmuch as in presence of that gas in excess, as their name indicates, they can not exist. With regard to the aërobes, their death is brought about by chemical means. The fatty principles, particularly abundant in sewage matters, are specially concerned; the oxygen is absorbed, the volatile fatty acids liberated, and these undergo so strong an oxydation that they often result in the appearance of formic acid. The equilibrium of the chemical medium of the microbe being thus destroyed, it perishes as an individual would perish after swallowing vitriol or inhaling sulphurous acid gas."

An adequate and wholesome supply of water is one of the problems which confronts every community, and it should not be forgotten that the demand increases steadily with the expansion of population and the growth of civilized habits. At present, about one-half of most water supplies is wasted in flushing drains and sewers, and in cleaning streets, and it is quite conceivable that the use of electrolyzed sea water for these and other purposes, in towns not remote from the seaside, would add immensely to the store of potable water. But apart from this important question, a system under which sewage can be robbed of all poisonous and noxious properties by chemical treatment is an ideal one. The use of antiseptics is becoming a new law of life. It now remains only to apply it to the disposal of our sewage, and thus to free soil pipes and sewers of all septic matters would be to destroy some of the deadliest diseases afflicting us.

Although sea water renders the application of the Hermite method considerably cheaper, it is not essential to it. When sea water is not procurable, a solution of chloride of magnesium can be used instead. Here a parallel chemical action is produced, giving precisely similar results. In every instance a central station has to be constructed and supplied with the necessary electric plant and convenient tanks, in which the disinfectant is prepared in sufficient quantities. By a simple arrangement of pipes the electrolyzed water is distributed through the streets, like the water for domestic use or like gas. It can also be conveyed into houses, and the contents of water closets, after being treated with the disinfectant, will help to purify the main drains and sewers instead of adding to their general contamination. The hygienic character of dwellings, so far as the absence of sewer gas is concerned, would obviously be greatly increased by this means, since there would be none of this deadly gas to escape through defective pipes and traps; and it has, moreover, been demonstrated by French bacteriologists that all these microscopic forms of life which "live and move and have their being" in sewage, and which wage a constant war upon the human race, will rapidly perish in the electrolyzed solution.

The report of a scientific and technical commission, composed of eminent sanitarians, chemists, and engineers, appointed by the municipal council of Havre to investigate the Hermite system, has just been given publicity. This commission, after prolonged experiments made at Havre on an elaborate scale, have formulated the following conclusions:

(1) That electrolyzed sea water is a powerful antiseptic and germicide.

(2) That the activity of the agent is in proportion to the quantity of chlorine; that is to say, an equal weight of chlorine acts more energetically and efficaciously in ten liters of water than in twenty liters, and in five liters than in ten.

(3) That the disinfecting action of the liquid is not instantaneons, but continuous, as long as there is an excess of chlorine remaining.

(4) That five grammes of active chlorine will, with sufficient time, completely disinfect the excreta of a normal dejection, and after two hours of contact all pathogenic germs will be destroyed and disappear.

The commission does not hesitate to declare the great value of M. Hermite's process of sanitation by electrolyzed sea water under the following conditions:

(1) That to act efficiently on the material to be disinfected, the electrolyzed water must be in sufficient quantity, and contain a minimum of 0.5 grammes of free chlorine per liter.

(2) That the excreta must be kept in contact with the liquid in the syphon of the closet or other receptacle, a sufficient length of time to insure the antiseptic action of the liquid before being discharged into the gutter or sewer.

From a financial point of view, the commission declares that the results obtained during the experiments with the Hermite system in the quarter St. Francais at Havre show that while the system gave excellent results from a sanitary standpoint, it cannot be considered an economical system, but requires further study and improvement before it can be recommended as applicable to large cities. Some doubt, moreover, is expressed as to whether a chlorine liquid of the kind can be applied freely to dwellings without producing disagreeable if not unwholesome effects, and without destructive corosion of metal pipes. The chlorine gas, it is believed, will pervade the house to a greater or less extent, imparting its disagreeable odor to the articles of food with which it may come into contact, and irritating the lungs of the occupants of the dwelling.

## Important Storage Battery Contract.

The most important storage battery contract yet negotiated in this country is reported to have been consummated by the Edison company of New York and the Electric Storage Battery company of Philadelphia. A total of 1,200 kilowatts capacity of cbloride accumulator cells will be installed in the Edison central station in New York, and the contract calls for the completion of the work by October 1st. The victory of the chloride cell in this instance is particularly gratifying, owing to the fact that foreign cells have been utilized in some of the principal eastern cities, and the selection of a cell made in this country may be regarded as significant of the progress of storage battery practice in the United States. The cells will be of 5,000 ampere hours capacity, the largest size manufactured by the company, and the installation when completed will be the largest storage battery plant in this country. The chloride cell has been fully described in this journal and several installations illustrated.

## Storage Battery Boat for the Erie Canal.

In an interview published in the *Herald* of Rochester, N. Y., Frank W. Hawley states that the subject of electrical transportation on the Erie canal is still under consideration and that a canal boat is now being equipped with storage batteries for an experimental trip. This boat will be ready for trial by September 10th and will be operated, it is said, between Albany and Troy. Mr. Hawley expresses confidence in the consummation of the project to transmit by electricity a portion of the power of Niagara Falls across the state of New York, and says that the work of laying the cables east of Buffalo will commence about the 1st of next April.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, August 6.—The final splice of the Anglo-American Telegraph company's new cable was made at 11 A. M. July 27th, and the laying of the largest cable across the Atlantic was then successfully completed. The steamship Scotia, which has been laying the deep sea section, paid out since noon of the day preceding the remaining 78 knots necessary to reach the position of the buoy holding the end of the Irish shore section laid by the Britannia, the ship which also laid the American shore end. The Irish shore end is 192 knots long. The time occupied in laying the new cable was the shortest on record. The expedition left Heart's Content, N. F., in the afternoon of July 15th, and the final splice was made July 27th or in less than 12 days. As the Irish shore end was laid in less than two days, the total time taken was inside of two weeks—a most remarkable achievement, when it is considered that this cable is of the heaviest type ever laid. A singular coincidence is the fact that the final splice was made on the anniversary of the day on which the first successful cable was landed at Heart's Content in 1866, 28 years ago, and not only on the same date but on the same day of the week. The new cable is laid between Heart's Content and Valentia, Ireland. It has a larger conductor than any other cable ever laid, containing 600 pounds of copper to the nautical mile. This increase of copper in the conductor means a proportionate increase in the speed of transmission; the new cable has, therefore, it is claimed, the greatest capacity of all long cables. It is, consequently, a valuable addition to the telegraphic facilities between America and Europe, and greatly increases the ability of the Western Union Telegraph company and its allies for handling transatlantic dispatches. The system comprises eight Atlantic cables, which are connected with New York not only by numerous land lines, but by two submarine cables running through underground leads from Coney Island to the Western Union cable office in Broad street, which insures communication in spite of the severest winter storms.

An electric trolley railroad is to be built between Asbury Park, N. J., and Branchport, to connect with the steamboat at the latter place running to New York daily. The right of way has been worked up very quietly, and negotiations were closed last Wednesday. The leaders of the scheme are Senator James A. Bradley and H. C. King. The work, it is said, will be begun at once, and, if possible, the eight miles of tracks and overhead wire will be in position by next fall.

For some time the project of running postal cars upon the electric lines of the Atlantic Avenue Railroad company in Brooklyn has been attracting attention, and the announcement that the experiment is to be tried this week will be received with interest by many who are inclined to favor the idea. For several weeks the mails have been carried from the postoffice to the South Brooklyn stations and the towns lying in the direction of Coney Island by the trolley cars. The Atlantic avenue company has built two special postal cars for use on its road. These are now completed and practically ready to be put into operation. They are fitted up after the manner of postal cars running on regular railroads, and the work of assorting and distributing the mails will be done in transit. When the mails reach the general postoffice they will be all ready for forwarding to New York, to other parts of the city, etc., only needing to be kept long enough to have the stamps cancelled. It is expected that so much time will be saved in this way and that the new method of carrying mails will prove so satisfactory that in the near future the system may be extended to other parts of the city. On Tuesday afternoon the trial trip of one of the new postal cars will be made. In appearance they are totally unlike other cars, and they will be certain to attract attention. Half of each car only is devoted to postal work; the other half will be used as a smoking compartment, and will undoubtedly prove popular with South Brooklynites. The postal compartment is fitted up with sorting tables, pouch-holders and all the other necessary paraphernalia for the rapid handling and distribution of mails.

The stockholders of the State Electric Light & Power company met on July 30th for the purpose of voting on a proposed increase of the capital stock from $200,000 to $500,000. The chairman stated that while the proposed increase was not all that the company would require in the future, it was not proposed to water the stock, but to call for such capital as was necessary to carry on the business. As more plants were required by the increase of the company's business, just the amount of capital necessary would be called for and no more. The propcsition was unanimously adopted.

W. F. O.

## PERSONAL.

E. M. Hert is to take the management of the Gibbs Electrical company, Milwaukee, Wis.

G. K. Wheeler of the Chicago office of the General Electric company is out of the city upon a pleasure trip.

Lord Kelvin has been awarded the grand médaille of the Société d'Encouragement pour l'Industrie Nationale of Paris for his scientific work.

Edward R. Grier of the firm of Grier Bros., western representatives of the Bryant Electric company, is taking a short trip through some of the New England states.

A. S. Doxsee, formerly connected with the New York Insulated Wire company's Chicago office, is now connected with the St. Louis Electrical Supply company as sales agent.

John R. Markle, Chicago manager of the western department of the Electric Storage Battery company, Philadelphia, will attend the Edison convention held in Boston on August 14th.

A. S. Krotz, of the Springfield, O., Railway company, has received notification that he has been awarded third prize by the Chicago General Railway company for the best plans of a model power house, car barn and repair shop.

W. W. Dixon of New York has opened an office in Temple Court building as an expert accountant and auditor. Having had a long experience in electrical business, he is especially fitted for anything in this line of work.

## ELECTRIC LIGHTING.

An electric lighting plant is being considered at Minden City, Mich.

Hamilton, Conn., is considering the qnestion of establishing an electric lighting system.

Goodland, Ill., has contracted a complete arc and incandescent electric light plant, to be owned by the town. There will be 22 arc lights on the streets.

Batavia, N. Y., after a long period of trouble over electric lighting matters, has now a plant in successful operation. It consists of two Fort Wayne dynamos and a 125 horse power Corliss engine. Eighty-one arc lamps for street lighting are provided.

The question of electric lighting is before the council of Elgin, Ill. A proposition to furnish 100 lamps of 32 candle power for $1,800 per year is now under consideration. It is said the mayor will veto it on account of its purpose to create a monopoly.

## TRADE NEWS.

The Consolidated Engineering company, St. Louis, Mo., has closed a contract with the city of Paducah, Ky., for a municipal street lighting plant, of a capacity of 120 lamps, for $17,316. The Standard Electric company's dynamos and Hamilton-Corliss engines will be used. The city will furnish real estate and buildings.

The James Leffel & Co. of Springfield, O., has issued a fine and complete new pamphlet illustrating and describing its well-known line of upright and horizontal steam engines and steel boilers with latest improvements, which was awarded a diploma and medal at the World's Fair. A copy may be had on application to the company. The book will be of interest to anyone needing an engine or boiler.

The twelfth annual edition of E. Hospitalier's book of the *Electricien's* formulæ is printed. M. Hospitalier's work is of great value and contains tables and definitions which are of much importance. This edition contains nearly 400 pages, exclusive of advertising matter, and is well illustrated. The decisions of the International Congress of Electricians at Chicago naturally find a place in the book, and the units there adopted are discussed.

The Standard Paint company of New York, manufacturer of the well-known P. & B. compounds, is presenting its friends with a beautiful Russia leather whist counter of unique design, having the usual arrangement for games and points and folding like a card case in the center. It is easily carried in the vest pocket. General Sales Agent F. S. De Ronde reports that the company is very busy and has not seen any falling off in sales, which, in fact, were larger for July than any previous month during the last year.

The Mather Electric company of Manchester, Conn., reports signs of marked improvemeot in the electrical business, the company now having on hand more work than at any other time for the last 18 months. The recent sale of its standard belted, and also of the new directly connected apparatus for lighting work, have been very large, necessitating a large addition to the working force in the company's works at Manchester. The Mather Electric company also records a good business throughout the western and central states, in which territory it is represented by its western contractor, J. Holt Gates of 1140 Monadnock building, Chicago.

The National Electric company of Eau Claire, Wis., has issued a pamphlet calling particular attention to the development of the direct current constant poteotial type of dynamo. This machinery is handled by the company and is fully described in the circulars. The necessity of producing an efficient machine has been fully realized, and the National company has not permitted this quality to be sacrificed in order to effect a saving in material or labor. By massing the metal uniformly in the magnetic circuit, by using wrought iron cores, and by carefully determining the proper field windings, a field of maximum strength with a minimum of exciting current is obtained. The efficiency is further promoted by properly constructing the armature core and arranging the winding with a view to reducing armature losses. Horne & Martin, Old Colony building, Chicago, represent the company.

Bradley & Co., Syracuse, N.Y., who control the interests of the Bunnell feed water filter and process, have issued a descriptive circular of their product. A Bunnell filter outfit consists of a filter, a steam pump for circulation, a pump for soda solution, a tank for soda solution, and the necessary piping. Single filters of proper sizes are provided for plants of 200 horse power to 500 horse power. For larger plants two or more filters are connected. The scale-producing substances in water, which consist of lime and magnesia, are held in solution by acids, and when deprived of their acid solvents become insolvent and may be removed by filtering. For depriving scale-forming substances of their acid solvents various chemicals may be used, but for this purpose soda ash seems the cheapest and most convenient material, and is in every way unobjectionable. It takes possession ot all the sulphuric acid first and then of the hydrochloric acid, the first holding in solution lime and magnesia as sulphates, and the second as chlorides. The sulphates and chlorides being deprived of their solvents are in a condition to be detained by any suitable filtering material through which the water may be made to pass. As soda ash neutralizes all the acids, corrosion and pitting are prevented. Bringing the water to a proper heat expels carbonic acid holding lime and magnesia in the form of carbonates, and puts them also in condition to be removed by filtering through proper material. Absolute precipitation, positive filtration and the thorough washing of filtering material at stated intervals are the three indispensable essentials that have been reduced to an exact science in the Bunnell filter and process.

## BUSINESS.

The National Telephone Manufacturing company, Boston, Mass., reports that it has just received an order for 1,000 telephones for the Hotel Majestic, New York.

The Simplex Electrical company, with western offices in the Monadnock building, Chicago, has secured the contract for caoutchouc wire to be used in the Congressional Library building, Washington.

The ease with which the Bryant chandelier pull-switch can be placed in position and the perfected construction and neat design are merits which will bring this specialty into favor. This is the most recent of the Bryant Electric company's specialties.

The Partridge Carbon company, Sandusky, O., which manufactures the Partridge self-lubricating motor brush, reports that it is receiving numerous gratifying orders, and that its goods are giving satisfaction. The self-lubricating motor brush is used upon a great many roads in this country.

The Walker Manufacturing company of Cleveland has just issued a catalogue of the type of power generators which it has placed upon the market. The machines present no novelty in design, but are said to be carefully constructed and of high commercial efficiency, able to stand an overload of 50 per cent. for a considerable time. The Chicago office of the Walker company is at 1644 Monadnock building.

The Columbia Electric company, Worcester, Mass., is meeting with considerable success in the introduction of its lighting system. The company manufactures its own dynamos and installs plants complete. Its electrical supply department represents a large and varied assortment of electric light and railway supplies. The company makes isolated installations a specialty and handles watchmen's clocks, annunciators, bells, burglar alarms, speaking tubes, etc.

Cushing & Morse, general western agents for Kerite, are highly elated over the recent World's Fair award for Kerite insulated wires for electric light service. As Kerite aerial, underground and submarine cables received the only award before the close of the fair, this recent award makes their triumph complete. They report that the soft braid now used on Kerite wire is much appreciated by the trade and that their business is constantly increasing, many large orders having recently been received.

The Mason Electric company, 7 Adams street, Chicago, is pushing the sale of Medbery insulating material. The Medbery insulating material commends itself to purchasers. The metal used is a high grade of aluminum bronze showing a tensile strength of 90,000 pounds to the square inch. The Medbery insulation shows a very high heat test and great strength. It is all handsomely finished and makes a very neat and strong equipment. It has been used for over two years by a number of the large traction companies.

The Electric Appliance company, Chicago, is making a specialty of prompt shipments on all orders for line material, shipping all orders for pins, brackets, cross-arms and insulators from Chicago stock. Prompt and complete line shipments of line material from Chicago stock will undoubtedly be appreciated by the trade, which has been frequently inconvenienced by divided shipments of line material, partly from factory and partly from Chicago stock. The Electric Appliance company carries a large stock of these goods.

The Mather Electric company of Manchester, Conn., has met with much success in the introduction of its new multipolar generator for electric lighting, and especially for electric railway work. The company has contracts for the installation of a number of these generators, some of which are of very large capacity for railway work, both in the East and West. The Mather Electric company will shortly enter with more activity than ever, into the railway field with these new generators for belted or directly connected work, which have already proved so satisfactory.

The Washington Electric company, 207 South Canal street, Chicago, manufacturer of the well-known Washington arc lamp, as well as other specialties, has done an excellent business since W. O. Meissner assumed the management of the company. Among the recent orders may be mentioned an installation of 15 8,000 candle power alternating current focusing lamps, which are to be used in the electric fountain in Schenley Park, Pittsburg. The lamps will be in place before September 1st. The company is also receiving a steady demand for the Meissner stage dimmers, which have been so perfected as to run noiselessly on alternating currents. The company has issued a descriptive catalogue, which it will send upon request.

The Gilliland Telephone company, 186–188 Fifth avenue, Chicago, reports a very favorable outlook. Orders are coming in rapidly and the factory is working at full capacity and making daily shipments of fifty telephones, and even at this rate it will be some time before back orders are filled. The company has been organized for several months and has been booking orders almost from the date of its organization. William H. McKinlock, president, and J. J. Nate, general manager, are both well known in telephone and electrical circles, with which interests they have been identified for many years. The vice-president and secretary of the company are gentlemen of ability and wide business acquaintance in other lines, and under such able management a successful future for this company seems probable.

The National India Rubber company, Bristol, R. I., has received a letter from Duncan Kennedy, U. S. Navy, dated from the naval torpedo station, Newport, R. I., regarding some tests upon N. I. R. cable after one month's immersion in salt water. The substance of the letter is as follows: "The double conductor N. I. R. cable submitted by the National India Rubber company, Bristol, R. I., has been tested and is satisfactory. The resistance of the insulation is 2,270 megohms per knot. The cable was further tested by cutting off about 10 feet and about 300 pounds hung to it, then knots were tied it it; it was twisted up tight and kinks made in it and hauled taut. In one kink the outside braiding was torn, but it was impossible to tear it again, though it was particularly tried. After this handling this piece was put in a barrel of water and tested for continuity and leaks. No injury seemed to have been done to the wires or insulation. The copper wires are tough and pliable, and the tinning seems to be well done."

The work of addition and improvement on the Narragansett Electric Lighting company's building and plants is now in rapid progress at Providence, R. I. A lighting and power service is to be given by the company. The increase on the plant itself is to comprise three new engines, three generators, two additional batteries o. boilers and an independent vertical condenser and pumpf The generators are to be of 750 horse power each, two of them to be attached to the Corliss engine shafts and operated without belts for the furnishing of power for factories, elevators, etc., and the third is for additional incandescent service. The independent vertical pump is to come from the Knowles Blake Pump company, and is the same as built for the Cramp Brothers and used in the record-breaking cruiser, the Minneapolis. The Berlin Iron Bridge company will build the superstructure, and the water tube boilers are to come from the National Boiler company of New Brunswick, N. J.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued July 31, 1894.*

523,653. Insulating Block. Henry P. Ball, Bridgeport, Conn. Application filed May 21, 1894.

An improved insulating guard wire block is provided, formed in sections, which are readily separable, and are so constructed as to be held from slipping on each other, and at the same time readily fitted together.

523,662. Electric Meter. Eugen Hartmann, Frankfort-on-the-Main, Germany. Application filed March 23, 1893.

In the instrument described, by the use of the current *z* in the drawing is pressed with a certain force upon *c*. The spring *F* can then be expanded by clockwork or the electro-magnet, and the contact in the clockwork being closed, and the arm *z* in contact with *c*, the electro-magnet *E* is excited, and *R* is pressed against roller *W*, which is forced to turn with the pull on the spring *F*, and performs a to-and-fro movement proportional to that of the spring. Directly the spring *F* is so far expanded that its power balances that of the wattmeter, the arm *z* quits the contact *c*, the electro-magnet circuit is thereby interrupted and *R* quits the roller *W*. A rotary motion is therefore imparted to the wheel *R* proportional to the current action of the wattmeter. The more electrical energy there is used the longer *z* remains upon *c*, because the spring *F* must be so much more expanded until equilibrium ensues, and for so much longer the electro-magnet *E* remains excited, therefore the wheel *R*, which is the first member of an ordinary counting train, is turned to such a greater extent. At every inward motion of the lever arm of the clockwork *U*, by which the spring is expanded, the electro-magnet circuit is interrupted at the contact lever, or, if for the continuous to and fro motion of the spring a special electro-magnet be employed, as shown in the drawings, its circuit will be periodically closed by the contact of the clockwork.

523,663. Commutator for Dynamo-electric Machines. Joseph Hoffman, Schenectady, N. Y. Application filed December 21, 1893.

The inventor moulds the insulation around two sides, and by preference around two ends also of the commutator bar, which is of the usual form; although, if desired, he may form the insulation around the entire commutator bar, and after the parts are assembled turn off the face against which the brushes will bear when the machine is in operation.

523,668. Dynamo-electric Machine or Motor. Walter H. Knight, Lynn, Mass. Application filed January 4, 1894.

The invention relates particularly to dynamo-electric machines of the multipolar type, and has for its object to provide a method of compounding which shall serve to counteract the effect of any eccentricity in the armature by which its distance from the different pole pieces is caused to vary; by which means also the inventor preserves an equality of potential between the different parts of the armature, so that the electromotive forces generated in each part are equal, and the armature is not unduly heated in any part. The invention consists broadly in varying the magnetism of the poles in greatest proximity to the armature proportionately to the increased electromotive force generated by this proximity; also providing as a means of equalizing the potential of the armature, a differential series winding which acts to demagnetize the pole in greatest proximity to which the armature runs; this differential winding is connected to the individual brushes and passes to the adjacent field windings, while the regular series winding in the work circuit is connected to the bus bars and derives its current from all of the brushes, or in the case of a number of generators from all of the various generators. In this way the increased output of any particular brush will tend to decrease the magnetic strength of the adjacent pole or poles so as to equalize the electromotive force delivered to the various brushes around the armature. As it is necessary to decrease the intensity of the magnetism in the pole when the current in the adjacent part of the armature is augmented, the wire which leads from the brush directly to this pole must be wound differentially to the main series winding. The inventor therefore leads from each brush or from every alternate brush a wire which makes a sufficient number of differential turns around the adjacent pole or poles, and then connects it to a common bus bar, from which current is supplied in multiple or in series to all the poles to form the ordinary series winding of the machine, as in other compound wound generators. It will thus be seen that the differential part of the series winding is individual and corrective while the direct part is general and accumulative. Two or more generators when thus wound come within the scope of the invention, and are connected as in the drawing, so that the main portion of their series winding is supplied equally from all the generators, while the differential series winding on each generator is supplied only with current coming from its own brushes.

523,685. Armature for Dynamo-electric Machines. Henry G. Reist, Lynn, Mass. Application filed September 15, 1893.

A winding is provided in this invention which consists of closed coils arranged in a peculiar way, the main feature of novelty being in connecting the coils in ranges running two, three or more times around the armature, with a connection taken from each coil to a commutator segment.

523,689. Process of Making Secondary Battery Plates. William L. Silvey, Dayton, O. Application filed September 22, 1892.

The inventor claims the process of making battery electrodes which consists in immersing anodes and cathodes in a solution containing a combination of acetic acid and potassium, subjecting the anodes and cathodes to the action of an electric current while in this solution, by means of which the anode is oxidized and deposited upon the cathode in a metallic state, then removing the cathodes from the depositing bath and compacting the deposit and then washing them in water, and placing them into a solution of sulphuric acid and water and charging them with an electric current whereby positive electrodes are produced.

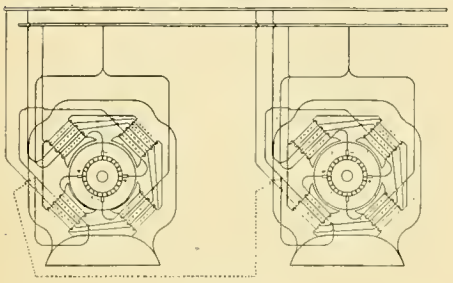
523,695. Electro-expansion Device. Elihu Thomson, Lynn, Mass. Application filed November 27, 1887.

The invention relates to certain novel devices for indicating the strength of an electric current or operating a valve or other device, and consists in the novel combinations of apparatus and features of construction wherein the heating effects of a current

of electricity upon a confined body of an expansible fluid, such as mercury, ether, alcohol or similar fluid are utilized In the accompanying drawings, Fig. 1 illustrates a form of apparatus in which the movement of expansion is utilized to indicate directly the strength of the heating current. Fig. 2 illustrates an apparatus in which the movement of the liquid or fluid under the expansive action of the heating coil closes an electric circuit, thereby operating directly as a switch. Fig. 3 illustrates a form of apparatus in which the receptacle is completely filled with the expansive fluid which, upon the application of heat, causes one of the yielding sides of the receptacle to bulge outward, carrying with it suitable devices to open or close a circuit, open or close a valve, or for other purposes.

523,696. Dynamo-electric Machine. Elihu Thompson, Swampscott, Mass. Application filed March 19, 1894.

The invention provides a method of balancing or equalizing the magnetic action of the field poles in a multipolar dynamo or motor, by which, if one of the field poles becomes less active in developing electromotive forces in the armature, it can be made sufficiently active to balance the effect of the opposite field pole. In the drawing *A, B, C, D* are four field coils surrounding and magnetizing the field poles on a four-pole dynamo. In the field between these poles the armature revolves, and is provided with four brushes. *1, 2, 3, 4*, on its commutator, the opposite brushes, *1, 3* and *2, 4* being connected up as positive and negative terminals. Should the electromotive forces generated between the brushes, *1, 2*, be greater on account of the superior force of the field pole *A*, or on account of the greater proximity of the field pole of the revolving structure, the brushes *1, 2* will be more active and take a larger proportion of the load than the brushes *3, 4*; that is, they will be traversed by a larger fraction of the total current, and, should the disproportion be very great, there



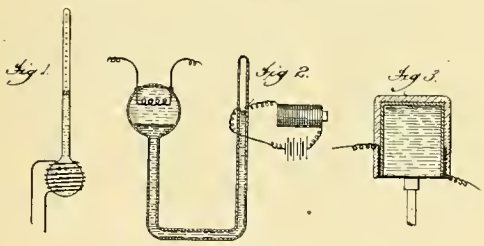
NO. 523,668.

would be danger of short-circuiting of the stronger brushes through the weaker ones. To avoid this the field coils *A, B, C, D* are provided with means for adjusting their strengths independently, so as to lower the strength of that pole which is too strong with relation to the others, or to raise the strength of that pole which is weaker in relation to the others, and thereby produce a balance of electromotive forces between the brushes of low polarity. A simple means of doing this is to excite the field coils, either in shunt or by separate excitation, and in the circuit of each coil to include variable rheostats in circuit with *A, B, C, D*. By varying the resistance in circuit a proper balance may be effected for any condition of load whereby equality of delivery from the whole four brushes to the circuit is secured, notwithstanding the irregularities of structure or position of the parts. In the drawing, however, the action is automatic, and the field coils are compound in that a suitable section of each coil, *A, B, C, D*, is either in shunt across the mains *M, M* or separately excited. The remainder of the winding is a series winding.

523,697. Arc Rupturing Device. Gardner T. Voorhees, Boston, Mass. Application filed May 8, 1893.

The invention consists in the combination of a circuit with insulated electrodes or terminals, the circuit being looped inclusively about the electrodes, whereby an arc formed from one electrode or terminal to another is ruptured by forces brought into play against the arc, by reason of the looping of the circuit in relation to the electrodes or terminals.

523,701. Automatic Circuit Closer. Joel W. White, Providence, R. I. Application filed March 11, 1893.




NO. 523,695.

In an automatic circuit closer the combination of a spring constituting one electrode and inner and outer supports for that spring when under tension, with a second electrode out of contact with the spring when under tension, but limiting the sidewise motion and permitting the endwise motion of the spring when released is described.

523,704. Electric Meter. Thomas Duncan, Fort Wayne, Ind. Application filed March 14, 1894.

The invention comprises improvements upon former patents granted to the same inventor upon electric meters for alternating work.

523,723. Railway Signal. Frank E. Kinsman, Plainfield, N. J. Application filed February 1, 1893.

The principal object of this invention is to provide for the case of a whole or partial failure of the electric battery or generator and consequent failure of the apparatus to work properly at the time that the conditions may require that a car or train should be stopped.

523,724. Electric Switch. George E. Linton, Worcester, Mass. Application filed March 22, 1894.

The improvements described by the inventor refer particularly to an adjustable spring on binding posts which contacts with the lever blade when the blade is thrown in a horizontal or operative position, and to the shape and construction of the lever blade which insure a more certain contacting surface than has been found in lever blades heretofore used.

523,758. Galvanic Battery. Charles E. Bull, North Plainfield, N. J. Application filed December 24, 1892.

The invention consists essentially in a battery cell containing an iron top plate and a copper bottom plate, together with undissolved crystals of copper sulphate and water.

523,767. Electric Signal for Railways. Charles A. Hammond, Boston, Mass. Application filed April 12, 1894.

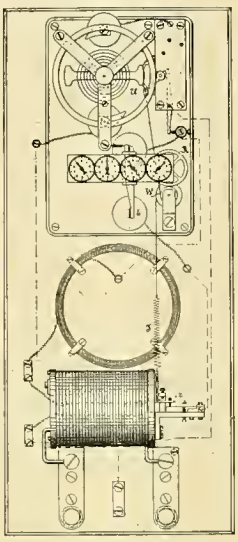
This invention has relation to an automatic electric block system for railways in which the track is divided into insulated sections, with appropriate signals and signal operating mechanism and circuits for the several sections or blocks.

523,776. Armature for Dynamo-electric Machines. Horace F. Parshall, Lynn, Mass. Application filed January 31, 1894.

The invention consists in new improvements for ventilating armatures of the smoothly wound type

523,779. Alternating Current Generator. Edwin W. Rice, Jr., Swampscott, Mass. Application filed July 25, 1893.

The invention consists in providing means for compounding two-phase alternating current generators for the maintenance of constant or approximately constant potential at the translating devices under variations of load.



NO. 523,662.

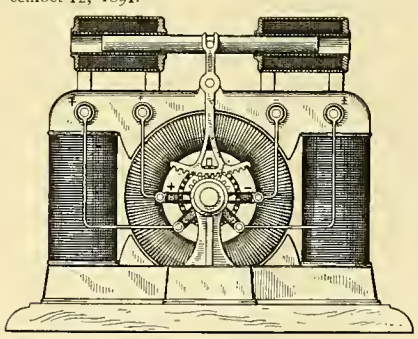
523,798. Means for Testing Electric Signal Boxes. Jacob F. Mehren, Chicago, Ill. Application filed November 24, 1893.

The apparatus described by the inventor includes in an electric signaling box, the combination with a main line circuit containing a signaling device and a relay of a branch circuit containing a portion of the wire windings of the relay, the branch circuit being adapted to be connected into and out of shunt with the signaling device.

523,805. Electric Converter. John A. Cabot, Cincinnati, O. Application filed September 22, 1893.

This invention relates to those electric converters which include an outer case containing a number of readily detachable cores surrounded with insulated primary and secondary wires; and the improvement comprises a novel combination of soft metal plates pierced with cruciform slots, and so compacted together as to form the shell, a series of H-shaped cores inserted within these slots, heads that retain the cores in their proper places, and fasteners that tie the various parts of the converter together.

523,822. Electro-magnetic Reciprocating Pump. Charles J. Van Depoele, Lynn, Mass. Application filed December 12, 1891.



NO. 523,822.

The engine comprises a reciprocating electro-magnetic engine, having motor coils and a magnetic plunger adapted to be reciprocated through them, the motor coils and plunger being arranged relatively in a manner adapted to many uses. The plunger, however, is different from that ordinarily used. With an electrically impelled plunger there is a limit beyond which increase in the strength of the field of force ceases to affect its armature, and, therefore, in order to provide for high service work the magnetic plunger by which the pump piston is driven must be of relatively large mass, the proportions, of course, depending upon the conditions to be met.

523,847. Electric Signaling Apparatus for Railway Trains. William H. Baker, Pawtucket, R. I. Application filed May 31, 1894.

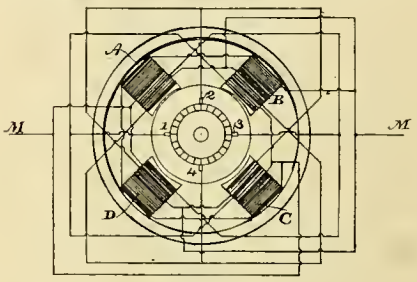
The principal object of the invention is to provide a contact device applicable to the exterior of an air brake hose coupling without changing its construction, and which will make a thorough connection with its mate on the interlocking coupling.

523,865. Testing Device for Electric Circuits. George A. O'Neill, Boston, Mass. Application filed October 20, 1893.

The invention consists in a series of normally open main circuits, containing manually operated closures, a series of contacts to which one terminal of each circuit is connected, a local alarm circuit responsive to an abnormal closure of any of the main circuits, a slitted contact plate co-operating with the series of contacts, and a generator in electrical connection with the plate, and thereby normally in circuit with the main circuits, combined with a common manually operated circuit breaker adapted to interrupt the main circuits, one at a time, and successively at the points of connection of the contact plate and terminal contacts, interruption of the abnormally closed circuit stopping the alarm, and thereby indicating the faulty circuit.

523,873. Fluid Pressure Regulator. Curtis H. Veeder and Edward D. Priest, Lynn, Mass. Application filed January 6, 1894.

The invention relates to controllers for regulators for mechanisms adapted to use compressed air or other fluid, and is especially devised to control the operation of railway brakes upon electric locomotives or cars. It has for its object to provide means by which a definite increase of pressure in the reservoir tends to suddenly throw on a resistance which acts to cut out current from the motor operating the pump, and by which the diminution of pressure consequent upon the use of the stored air withdraws the resistance from the motor circuit slowly, so as to start the motor at a low speed, which will increase in accordance with the demand for air and as such demand affects the pressure in the reservoir. Means are also provided by which, upon a sudden cessation of current for any reason, the resistance will be thrown in, so that, should the current be thrown in again suddenly, the motor will not be in circuit without resistance and with no counter electromotive force, by which means injury to the motor is prevented, and the apparatus is adapted for absoluteiy automatic operation within reasonable limits.




NO. 523,696.

523,889. Automatic Line Discharger. Jacinto F. Ganduxer, Gracia, Spain. Application filed November 4, 1892.

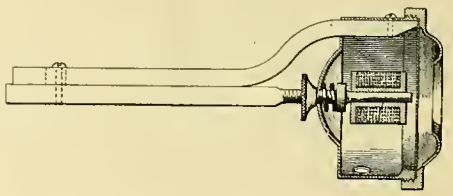
The invention consists in an electro-magnet, an armature lever carrying an armature, and prolonged between a pair of electrical contacts, a retractile spring for holding the armature lever normally against the back contact spring, and line and ground connections to be inserted in electrical lines, and which will discharge the lines when an abnormal current passes.

523,892. Galvanic Element. Albrecht Heil, Crumbach, Germany. Application filed September 27, 1893.

A galvanic element consisting of a negative electrode attached to a conducting support made of a base metal, a depolarizing compound in which the electrode is embedded, a bag containing the depolarizing compound and tightly fitted around the conducting support, a felt diaphragm surrounding the bag and a positive electrode located exteriorly of the diaphragm are combined.

523,893. Bushing for Electric Arc Lamps. Thomas J. Houck, Baltimore, Md. Application filed April 23, 1894.

The invention is designed to provide a detachable and adjustable bushing for carbon holder guides, which may be tightened or adjusted from time to time to take up wear, and always hold the upper carbon holder and its carbon in true vertical alignment, and at the same time to avoid the necessity and expense of throwing away the old guides and replacing them with new ones.



NO. 523,927.

523,927. Magnetic Telephone. Frederick H. Brown, Chicago, Ill. Application filed November 25, 1893.

The invention consists primarily in a bifurcated permanent magnet, one leg of which magnet has a greater cross-section of metal relatively to the other leg of the bifurcated magnet, both of these legs being of the same polarity, while the extended arm is of a different polarity than that of the two arms, this variation in the cross-section of metal of the bifurcations providing two magnetic poles of varying relative strength, one of which poles being connected directly and electrically with the diaphragm, while the latter is free to vibrate over the other pole and through the magnetic field of force established thereby.

523,946. Bank Safe. Daniel M. Rothenberger, Lancaster, Pa. Application filed May 17, 1893.

The invention consists in surrounding a safe with a compressed air chamber, in combination with means for sounding an alarm by reducing the air pressure: in the attachment to the safe of a device by which the air pressure can be reduced in case of fire, and in the attachment of a device by which the air chamber is flooded with water when approached by fire.

523,957. Electric Welding or Brazing Mechanism. George D. Burton, Boston, Mass. Application filed June 3, 1893.

The particular improvement which has been made is the employment with a carbon pencil, or its equivalent, to produce an electric arc for brazing or welding, of a liquid containing a cell so disposed as to force the current of electricity to flow through the liquid therein as a part of the circuit.

11,433, Electric Arc Lamp. Joseph B. McKeown, Cleveland, O. Application filed for reissue May 22, 1894.

The invention relates especially to the mechanism for feeding and controlling the carbon rod in arc lamps, and has for its object to provide a simple and efficient means of construction.

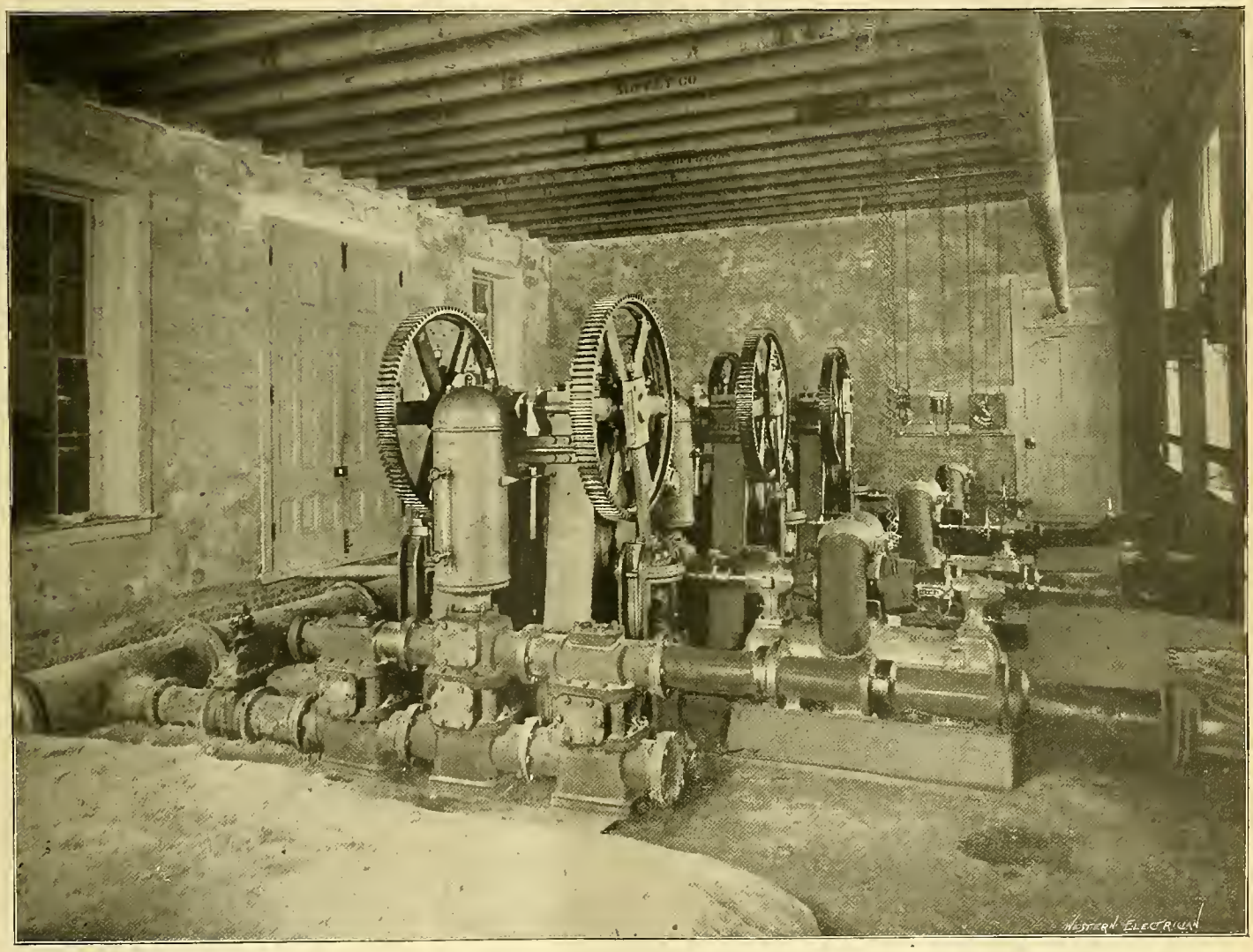
# Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, AUGUST 18, 1894. No. 7


## Electric Pumping Station at San Antonio, Texas.

Perhaps no other class of machinery has been called upon to meet conditions more unfavorable to its operation than has the electric motor. So urgent has been the need of machinery that could be isolated from its source of supply and operate practically without attention, that the development of the electric motor has in some particulars been more rapid than any other class of machinery. Although this power factor has now become recognized as reliable and able to accomplish results not to be expected from steam, compressed air or other systems of mechanical power, its desirability for application to water pumping purposes was for a long time questioned. The strains to which a motor utilized for this purpose is subjected are obvious. Yet where electric power is available there is great economy in the use of electric pumps over steam pumps for elevators and general water supply. By the use of electric pumps the boilers, heavy foundations, steam piping and nearly everything needed with steam pumps is entirely done away with and even the constant services of an engineer in many cases becomes no longer a necessity. The electric pump may be arranged to automatically regulate the pressure in the tank so that it may be kept constant at any fixed point. The application of such a combination under special conditions for breweries, tanneries, etc., is becoming more numerous as the motors prove their ability o give satisfactory service. An interesting example of this may be found in the electric pumping plant for the municipal water supply of San Antonio, Texas. As seen in the illustration presented upon this page, which is a general view of the pumping plant at that city, three ten by twelve inch Gould's triplex pumps are being operated by electric motors. This is probably the first electric pumping plant for supplying a city with water. It was erected in February, 1893, and has been in continual operation since, and is said to have given very satisfactory service. The illustration is from a photograph taken shortly after the plant was put in operation and before the flooring was put down, so that the system of piping may be seen. The total capacity of the station is estimated at about 2,500,000 gallons a day.




ELECTRIC PUMPING STATION AT SAN ANTONIO, TEXAS.

The motors for this installation are of the C. & C. standard type and of 30 horse power capacity each. They are geared directly to the pumps, which run at a speed of about 50 revolutions a minute. The motors are supplied with current from the street power mains at 500 volts pressure, each motor having an automatic starting box and a recording wattmeter. This station has attracted considerable attention and its operation has been watched closely. Although this is the first plant of its kind fitted out by the C. & C. Electric company, several eastern cities have been considering the installation of similar apparatus, and one contract has been let.

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The lamp and electric committee of the common council of Rochester, N. Y., is investigating the problem of guard wires for the trolley wires.

## Trouble at Benton Harbor.

W. Worth Bean, president of the Benton Harbor & St. Joseph, Mich., Electric Railway company, was arrested on Sunday, August 12th, for shooting Alderman Shriver in the leg. The affray grew out of a dispute between the town authorities and the railway company in relation to the removal of the tracks on East Main street. The city desired the ties and rails removed in order that the street might be re-graded, asserting that the franchise had been forfeited owing to the failure of the company to make a desired extension. The company held that its franchise was valid, but at the city council meeting on the 6th the city marshal was directed to serve notice on the company to remove its track within one week. The order was not complied with by the railway company, and at five o'clock on the morning of the 12th a force of laborers was set to work tearing up the track under direction of Contractor James Pearl and Alderman Shriver. Suddenly a street car appeared on the scene, in which were President Bean, Superintendent Mason, Secretary Hull, Mrs. Bean and several conductors and motormen, all provided, it is said, with firearms. Mr. Bean ordered the track-wreckers to desist from their labors. During a heated discussion Contractor Pearl placed some paving blocks on the track to prevent the car from running over the contested strip. Mr. Bean then leveled his shotgun at Pearl, but Alderman Shriver stepped in front of the contractor and received the charge of shot in his leg. The wound is serious but not believed to be fatal. Only one

shot was fired. President Bean was arrested soon after the firing, and he was held in $2,500 bail to appear in court. He asserts that the shooting was entirely accidental. After the clash the track-wreckers again went to work and the disputed strip of railway was completely ripped up and hauled away. The affair has created a sensation in Benton Harbor and will excite much surprise among electrical and street railway men generally, among whom Mr. Bean is widely known.

## The Siemens Company.

In the last issue of this journal views of the ruins of the Siemens & Halske Electric company's factory at Chicago were presented. In the article accompanying the illustrations it was announced that it was rumored that negotiations were in progress to lease the plant of the Grant Locomotive Works at Cicero, with the intention of continuing the manufacture of electrical machinery. These negotiations have been brought to a successful close, and operations have already been begun by the company to manufacture some of the electrical machinery called for by important contracts. A view of the entire plant of the locomotive works is presented in the accompanying illustration, which gives a good idea of the extent of the works. The large buildings include the blacksmith, hammer, machine, erecting, boiler and wood shops, and the foundry, boiler house and offices. The works are located upon the line of the Wisconsin Central railway, about six miles west of the center of Chicago. The buildings are all of brick, erected in the most substantial manner and provided with the latest machinery and labor-saving devices, including four immense electric cranes. The electrical features of the plant were described and illustrated in the WESTERN ELECTRICIAN of March 19, 1892.

Until it was leased to the Siemens & Halske company the plant of the Grant Locomotive Works was in the hands of the assignees and the factories were idle. The petition of the assignees, William K. Ackerman and James Wilson, filed in the County Court, presenting the proposition of Siemens & Halske company, shows the terms of the transaction which enables the company to take possession of the works. The company leased the entire plant for one year at a rental of $12,000, subject, however, to a termination of the lease upon three months' notice, and agreed to keep the premises in good repair. The activity and decision shown by the Siemens & Halske company is highly commendable and the success of the company in securing facilities for carrying out its contracts is gratifying.

The announcement of the formation of a new concern embodying the interests of the Siemens & Halske Electric company of America, the Wells-French Car company and Grant Locomotive Works, under the corporate name of the Siemens company and with a capital stock of $2,000.000, will attract great interest. The plant of the Wells-French company was situated near the old Siemens & Halske factory and suffered some damage in the fire of August 1st. O. W. Meysenburg of the electric company is president of the Wells-French company, and has placed himself upon record as admitting that the consolidations of the several interests were in contemplation, and Assignee Ackerman of the Grant Works states unreservedly that this enormous consolidation is practically insured. The advantages to be derived from such a combination are obvious, as there is ample capacity at the works for producing the machinery of the Siemens & Halske company, the cars of the Wells-French company and the locomotives of the Grant people. The separate products of the three old companies will be turned out by the company and the concern will in that case develop into one of the largest manufacturing corporations in the country. Other than local interests must be consulted before such an arrangement can be consummated, but it is regarded as probable that the Siemens company will eventually possess one of the greatest manufacturing establishments of Chicago.

## Chicago Fire and Police Telegraphs.

Chicago is spreading out so rapidly that the fire and police telegraphic alarm system shows a steady growth every year. Extensive additions are now being made, and City Electrician Barrett reports that by January 1, 1895, there will be 1,450 fire alarm boxes and 825 police patrol boxes scattered throughout Chicago's wide area. Each of the 92 fire engine stations is, of course, electrically equipped, and there is a large quantity of police signaling apparatus in the various precinct houses.

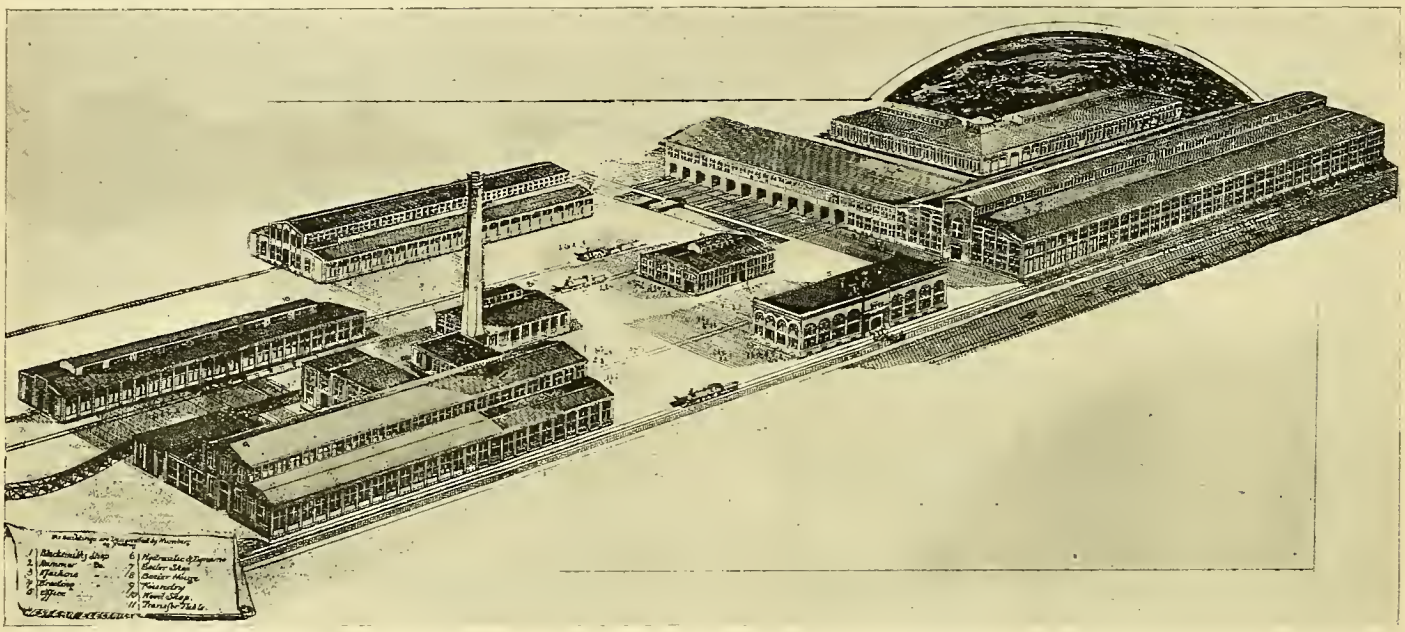
## Electrical Transmission of Power with Two-phase Currents.

An interesting application of the distribution of electrical power by the two-phase alternating current system has been made at the Decizee collieries in France. The installation will include, when completed, a number of 30 horse power motors for ventilating purposes, one of 15 horse power for hoisting, one of 12 horse power for pumping, 30 arc and about 600 incandescent lamps. A general idea of what is accomplished may be had from the following table:

| Site | Distance from generating station | Machin'y or lamps receiving current | Use. |
|---|---|---|---|
| 1—West Chagnats Shaft... | Yards. 5,090 | 30 horse power motor. | Ventilating fan. |
| Breaker at Lacets. | 3,466 | 30 horse power motor. | " " |
| Coupes shaft .... | 2,058 | 30 horse power motor. | " " |
| Zagots shaft ..... | 1,084 | Electric hauling machine of 15 horse power. | Inclined plane. |
| 2—Generating station. | | | |
| Various installations..... | ..... ..... | Six arc and 100 incandes'nt lamps | Lighting |
| 3—East Breaker at Marizy. | 1,300 | 30 horse power motor and 24 arc lamps. | Ventilating fan and lighting |
| Sorting and washing shops of the Pré-Charpin.... | 2,490 | 500 incandescent lamps | Lighting |
| Champvert ..... | 3,250 | 12 horse power motor. | Pumping. |

The generating station, an elevation and plan of which is shown in Fig. 1, is located at a distance of 3.1 and 1.86 miles from the extreme points of application. It contains a battery of six boilers and two units (steam engines and dynamos) each of a capacity of 100 kilowatts. It is the intention to ultimately install a third unit to complete the power capacity originally planned for the station and provide a reserve. The two units now installed may be run separately or connected in parallel. The boilers are of tubular construction, and the furnace beds are sunk considerably below the level of the ground. Fuel is furnished by a narrow gauge road which has been laid along the side of the building, the coal being dumped directly into the furnace room from the cars, which are also used to carry away the ashes. This arrangement has reduced the cost of operation of the steam generating plant to a considerable extent.

The engines are of the Corliss horizontal non-condensing type with fly-wheel governors, running at 200 revolutions per minute, and driving the diphase alternators by means of belting. A notable feature in this connection is the fact that each electrical unit comprises a twin alternator, or in reality two machines, placed one at each end of the shaft, the driving pulley carrying the engine belt being arranged in the middle of the shaft, as shown in Fig. 2, which is a view of the generating room. Each of the alternators generates ordinary alternating current; the fields, however, have been so keyed to the common shaft that the potential differences at the terminals of the two dynamos show a difference in phase of one-quarter of a period. The generators are Zipernowsky 10-pole alternators, with a revolving field of the radial laminated type. The 10 field magnets are connected together in series, and the exciting current is led to them by means of two rings carried on an extension of the driving shaft on the opposite side to that of the driving pulley. Two ordinary brass brushes press upon these rings, to which the exciting current is furnished by a single exciter operated by a belt from the shaft of the alternators. At 900 revolutions a minute this direct current dynamo furnishes current of between 25 and 30 amperes at 110 volts. The fixed armature of the alternators consists of ten coils slipped over projecting pieces bolted to the interior of the outer frame, and which may be withdrawn and replaced without any trouble. Both frame and cores are laminated.



THE SIEMENS COMPANY.

The motors are similar in construction to the dynamos regarding the fixed parts, but have double the number of poles. For those of 30 horse power the number of poles is 16, that is, eight for each circuit, connected in series. The induction in the cores is 4,500 C. G. S. units, or 4.5 kilogausses. The currents create a rotating field of a velocity of 650 revolutions a minute. The armature has a hollow cylinder as a core, carrying tangential coils in grooves. The armature is short-circuited for normal running; for starting, the two currents are led out through sliding contacts to two resistances consisting of metallic plates immersed in a solution of sulphate of copper. When not loaded the speed is only one per cent. below that of synchronism; for half the charge it is 2½ per cent., and for full charge from five to six per cent. The induced currents in the armature represent almost the entire work corresponding to this loss of velocity. The efficiency is estimated at 80 per cent. at half load and 88 per cent. at full load. The poles in the 30 horse power motors are connected in series, but wound alternately right and left handed. A resistance is inserted in each of the two armature circuits. Of the four wires from the two windings two are connected, giving three wires, one of which is neutral. An application of one of these motors is shown in Fig. 3, where it is driving a fan for ventilating a mine. These diphase motors are easily set in motion and are left practically to themselves for several hours at a time. The sub-stations

are situated in the forest and the facility of working on this system as compared with the erection in each place of a boiler, steam engine and ventilating fan, is considered to be remarkable, aside from the cost of transporting fuel—a considerable item.

The current is transmitted mainly by means of overhead wires to the points of utilization, the only portion laid underground being toward the end of the principal line leading the to Chagnats pit. The wires forming the line are of silicion bronze and are carried on double petticoated porcelain insulators attached to poles 24 feet high. The diameter of the wires constituting the principal line to the western part of the district is six millimeters and four millimeters in the remainder of the line. It is interesting to note that the same poles carrying the transmission wires also support telephone wires, the latter being arranged 12 feet from the ground. In order to counteract the effects of induction in the telephone wires, the line conductors are crossed at distances averaging 540 yards. The small portion of underground line is formed of a lead covered cable laid in a wooden conduit, as is also the telephone line for the same distance. Suitable lightning arresters are provided at the generating and sub-stations and at intervals along the line.

The switchboard is shown complete in Fig. 4. The respective part of each piece of apparatus is equivalent to the same apparatus designed for simple alternating current work. Two pairs of transformers are placed outside of the board and are designed to facilitate the throwing in parallel of the two groups of alternators. The accompanying illustrations are reproduced from *L'Industrie Electrique.*

## The Corrosion of Iron Pipes by the Action of Electric Railway Currents.[1]

O. M. Rau, Milwaukee: We had a case in Milwaukee which leads me to believe that the condition of the soil is as much responsible for the corrosion as the electric current. On a railway line built about four years ago a No. 4 copper wire was laid as a supplementary track feeder. On investigating the condition of this wire recently it was found to be entirely eaten away on the lower end of the line and on the upper end in as good a condition as when new. The electric conditions were the same all over this line, as the power house is situated in the center of the circuit. From this instance as well as others, I do not believe the leakage of electric current will noticeably affect a pipe unless the chemical nature of the soil is favorable to this action. In a number of places where the water pipes were affected special care was taken as to the kind of filling used, lake sand or gravel being considered best.

A. V. Abbott, Chicago: Prof. Jackson has given to us an exceedingly valuable contribution to engineering literature. He has accurately determined the amount of corrosion per ampere hour, or per unit of electrical energy expended, forming data from which we will be able to make calculations as to the probable effect of the corrosive action. He has also demonstrated what is still more important, namely, the amount of electrical pressure which is required, not only to initiate the trouble, but to constantly maintain the action. These experiments are in line with those made by Mr. Farnham, who showed in one experiment that a piece of lead wire about three inches long and nearly 1-16 inch in diameter was dissolved in pure hydrant water; that is to say, in water as pure as is obtained from the Boston water works. The lead was entirely dissolved, with an electrical pressure of 1-100 of a volt, in about a week's time—a result which is not only confirmatory of Mr. Jackson's investigations, but furthermore points to the conclusion that very small quantities of the electrolytic salts, to which Prof. Jackson has called attention, are sufficient to initiate and to carry on corrosive action. The actual amount of lead which passed into solution was not very great, but all examination upon the injury done to underground structures has shown that the difficulty arises from an extensive pitting of the metallic surface; a single hole will incapacitate a 30 inch water main as seriously as if the whole pipe were dissolved.

The amount and rapidity of the corrosive action seems to vary greatly in different localities and under different circumstances. The first action was noticed in Boston, in the summer of 1891, three years or more after the first installation of the electrical system of the West End Railway company. Injury was first discovered by the telephone company in Boston, as affecting the lead sheaths of their underground cables. The Boston reports indicate that some of the smaller surface pipes, both of the water and gas systems, have been injured, but no damage is reported to have occurred to the large mains, although the engineers of the West End railway have expressed an opinion that there is a probability of the existence of extensive corrosion. In the Brooklyn experience, however, within a very few months after the substitution of electrical propulsion for animal traction, extensive injury to the largest gas and water mains in the city was noticed, injury which, in Court street, necessitated the replacement of several lengths of large gas main.

Mr. Jackson has shown very clearly that a pressure of 1-1000 of a volt is sufficient to cause injury, if this action is allowed to continue. Should all electrical industries be allowed to pour their energy indiscriminately into the earth, it would be only a short time when such small differences of potential as this would be found all over the areas covered by our towns and cities. It is, therefore, merely a question of time when underground structures will be seriously menaced and rapidly destroyed by currents of this kind.

Some years ago I had the good fortune to construct about three hundred miles of electric railway. At present I represent the engineering department of the Chicago Telephone company, and so have been on both sides of the fence and have had fair opportunities to see and consider both sides of the question. In my earlier electrical railway experience the double trolley was still in vogue, and I constructed several roads of this kind. I have always advocated the idea that each individual electrical company, no matter what its business, ought to have its own complete, entire and private circuit. The idea of constructing arc light plants, incandescent lighting stations, telephone and telegraph circuits and electrical railway lines, with the probability in the future of an indefinite extension of electrical circuits, and to dump the entire energy from all such sources into a common tub, is absurd.

In any other kind of engineering such mutual interference would not be tolerated for a moment. Already every electric lighting company is required by law to provide its own independent and private circuit. Nearly all the telephone companies are rapidly changing their lines from grounded circuits to metallic circuits, not only on account of the injury to which they are subjected from the other electrical companies, but also because experience has shown that the service obtained by the use of the individual circuit is attended with far better results. By this means each company secures a private right of way peculiar to itself, which not only does not interfere with other circuits, but is not interfered with by other circuits.

A few moments since, Mr. Jackson showed that by the construction either of a double trolley road or by providing an electrical road with a sufficiently adequate return circuit the question of injury to underground structures, no matter what they may be, is completely and satisfactorily solved. This is also the remedy proposed by Mr. Farnham.

In the case of Chicago little or no trouble has as yet been experienced with underground structures, because the trolley roads are now only in the outlying parts of the city, where a minimum of metallic underground structures exist, and where the earth is in good condition to form a return circuit. Only a few trolley roads have at present been placed in operation, and those have been only operated for a short time. The electrical road, however, is bound to extend, and doubtless, in some form or other, will penetrate to the heart of the city before many years elapse. Some of the Chicago elevated roads are already taking up the problem and preparing to change their equipment to electrical propulsion. Unless they provide themselves with an individual circuit and build that circuit in such a way that underground structures will not form a path for the current, trouble will, sooner or later, occur.

From investigations in Brooklyn and other cities it has been shown that in some cases the current followed a gas or water main, skipping along the main from point to point, running from the main into the earth, and from earth back into the main, depending upon the resistance of the joints. Thus many points of corrosive action were initiated, resulting in widespread and extensive injury to the pipes. The occurrence of such a result will be more and more frequent as trolley roads increase in number and extent and as more current is dumped into the earth.

A few minutes ago Mr. Rau related an experience in Milwaukee, where the difficulty was overcome by excavating around the water mains and return electric circuit and introducing clean gravel or sand. For a very limited district such an expedient may be a success, but it would be utterly impracticable to equip a large city upon this plan. Neither does it seem possible that such an expedient should be a final remedy for the difficulty. The constant accumulation of organic salts in the streets, from animal refuse, would sooner or later impregnate the cleanest and freshest soil with a sufficient quantity of decomposable organic acids to initiate corrosive action. It appears to me, then, that the remedy lies with the engineering societies, which should formulate such specifications and restrictions, applicable to various electrical industries, that should on the one hand protect existing structures and on the other encourage the development of electrical enterprises by securing such an improvement in both the quality and quantity of the materials and workmanship as shall obviate the defect of poor and cheap building, so forcibly pointed out by Mr. Jackson.

The advantage of the electric road lies in its economical construction. The best cable roads cost from $125,000 to $200,000 per mile, while a first-class trolley may be built to cost not over $60,000 a mile. The electrical road attracts the capitalist because he can earn more on his investment in this form than in any other. The single trolley road offers a special inducement, from the fact that it requires only one-fourth the copper necessary for the double trolley, and consequently requires a proportionally decreased investment for its original installation, but electrical railway engineers are finding that this is an expensive economy. In my own experience I have seen a return circuit through rail bonds, running so hot that for a space of one thousand feet the bonds have burned their way through the ties, allowing the rails to spread to such an extent as to derail the cars. All energy thus lost in these rail bonds demanded a correspondingly greater expenditure of coal, and to that extent diminished the earnings of the road. Quite commonly it has been asserted that an electric railway can be built for $30,000 a mile, but after construction has been undertaken upon this basis it has been impossible for such roads to pay any dividends. In the past the work has been done not too economically, but too cheaply. If the capitalist would take the advice that the engineer usually gives, if he would plan his entire circuit, both the outgoing and the return branches, in such a manner that not over five to eight per cent. of the energy generated by the station is consumed in the circuit, half of the electrical roads now in the hands of receivers would be earning and paying good dividends. They already have the necessary business, and the question of dividends is one of the most economical operation and maintenance. Assuming an interest and depreciation account of ten to twelve per cent., a very little calculation will show that in nearly every road in this country additional copper

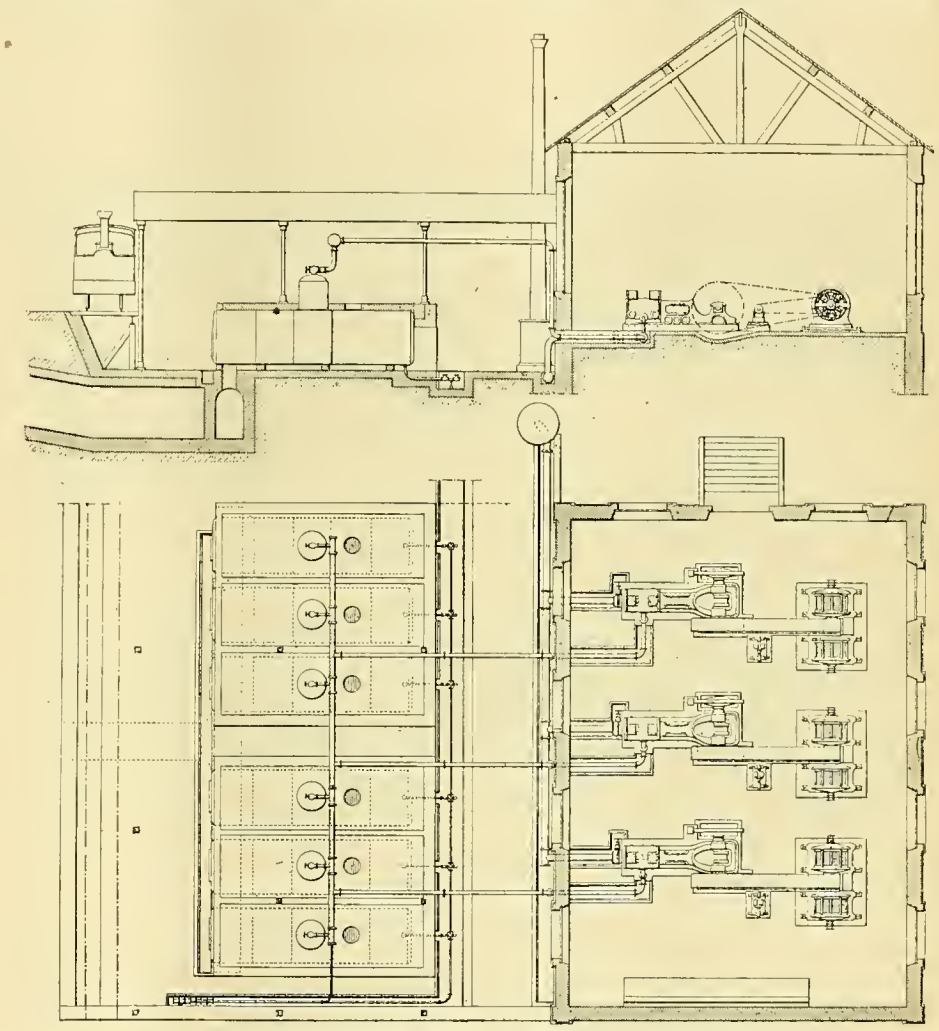


FIG. 1. ELECTRICAL TRANSMISSION OF POWER WITH TWO-PHASE CURRENTS.

1. Discussion of D. C. Jackson's paper, Western Society of Engineers, Chicago, July 11, 1894.

in the line circuits will earn a good return on the investment. Therefore, it seems to me that the way lies in improving electric railway construction to such an extent that it is not only the best engineering construction, but in the end cheapest for the capitalist and safest for other enterprises.

MR. SHNABEL: I would like to ask what objection the companies have to putting in this return wire?

MR. ABBOTT: It is simply a question of the cost of the copper.

PROF. JACKSON: The actual cost of circuit is increased about three-fold. It requires four times as much power of the same potentiality in the circuit and four times the amount of copper. Of course the labor of insulation is considerably cheaper.

MR. SHNABEL: How often would that have to be connected with the rail?

PROF. JACKSON: The oftener the better, in fact when we come to the double trolley road, they have a continuous connection.

GEORGE WESTON: You do not depend upon the rail at all?

MR. ABBOTT: In the double trolley you do not depend on the rail at all. Depending on the rail succeeds perfectly so far as distribution of energy to the cars is concerned, but does not prevent the current from leaving the rail and passing to other metallic structures. The difficulty is due, as Mr. Jackson as shown, to the small amount of electric pressure that is enough to start and continue the corrosion. If there is a railway extending along a street and a thousandth of a volt on a pipe three feet away from the rail is going to start corrosion on the pipe, it takes a great deal of copper to protect the pipe. If the railway circuit is independent of the earth, there can be no danger; if there is sufficient metal in the return circuit, other underground structures may be protected.

MR. WESTON: In the case of independent return wire carried on a pole the same as a feeder, would a rail connection every five hundred or a thousand feet protect it?

MR. ABBOTT: That would be a great protection; but it is questionable if 500 or 1,000 feet would be often enough. Without experiment I should say that it would be well to connect the rail to the return wire at every pole, say every 100 feet. The expense of the connection alone would be very small.

PROF. JACKSON: I think that the more frequently connections are made within the danger district especially, or the district in which the action is most severe, the better will be the result.

MR. DAVIS: We would infer that you consider that it is a necessity in all roads that have return circuits through the rail to connect with the water pipe also.

PROF. JACKSON: Within the district where the pipes are positive, where the currents are returning. As long as the current is flowing into the pipes there is no damage done whatever, but in any portion of the railway system, any portion of the district served in which the current flows from the pipes to the railway, then the greatest care must be exercised. That danger district can be very readily determined by proper measurements carried out carefully, and the connections can be made in such a way that I think undoubtedly in almost every case—and it is true in some cases that I have seen where the work has not been done well—that in almost every case the conditions can be carried out in such a way as to avoid damage. In a large city, such as Boston or Brooklyn, the currents to be carried are so enormous that the amount of copper is appalling when looked at in tons or carloads; but as I said, the cost of the total amount of copper is a small matter compared with the total amount of the cost of the road.

MR. ABBOTT: Generally speaking, not more than 10 per cent. of the cost of the road.

PROF. JACKSON: You double that by preventing any damage that will in future add to the capital charge.

R. P. BROWN: I would like to ask if you expect the lake sand around the pipes to do away with the difficulty? Might we not expect that after you get the nitrates from the circuits, the same difficulty will arise?

MR. RAU: We have carried on most of these experiments in yards and around service pipes which lead from the water mains, so it has generally been in places protected from the foreign substances which are collected from the roadway. From the depth a water main is laid. I do not think they would penetrate through to the pipe.

MR. BROWN: If it was from that cause, I can see how that might answer for a little while, but it seems to me it would be only a short time.

PROF. JACKSON: In a portion of a district that would be simply a temporary relief.

MR. RAU: In most cases this has overcome the trouble to such an extent that where formerly a new pipe was needed every six to eight months we have not had to replace one in two years. And in these places I believe the relief to be quite extended. At any rate if drainage is fair this plan is to be recommended.

MR. APPLETON: The matter of using electricity on elevated railroads I think was mentioned by Mr. Abbott, who referred to the danger of the return current running down the column to the ground. In talking with others on that point I have maintained that the circumstances were entirely different from an ordinary surface railroad; that in one case the rails were laid in the ground surrounded by earth, and in the case of the elevated railroad the rails were laid on dry wood ties that were in no way connected with the earth, and the insulation of the tie would prevent anything of that kind. Hence there would ordinarily be no danger except in case of prolonged rains when the ties might become watersoaked.

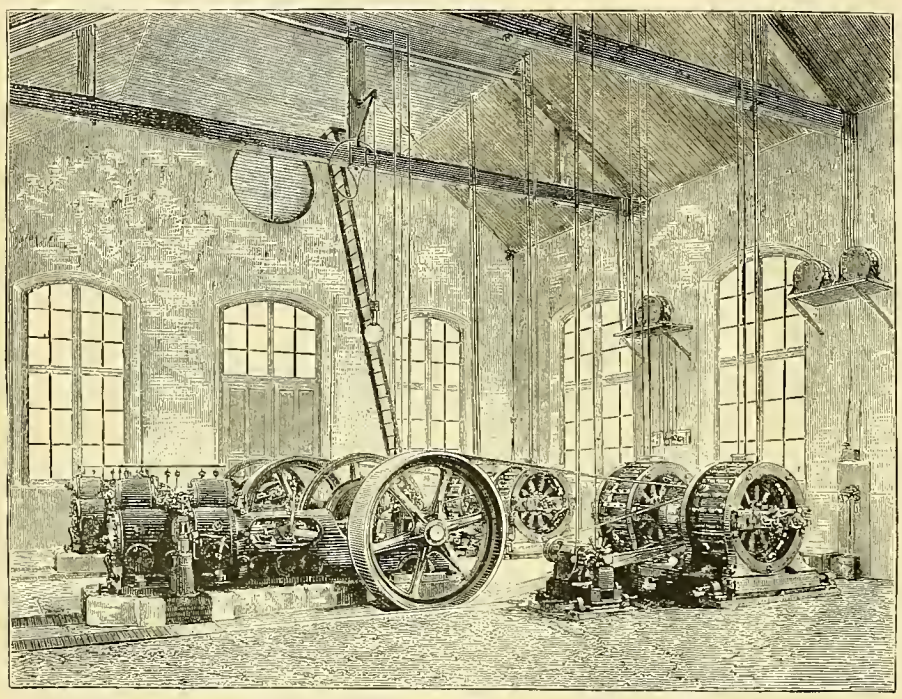


FIG. 2. ELECTRICAL TRANSMISSION OF POWER WITH TWO-PHASE CURRENTS.

PROF. JACKSON: Taking the traffic on the average railway the rails would be nominally of sufficient capacity. There are quite a number of street surface railway plants in this country in which the rails, which concentrate toward the power station, are not sufficient to carry back the current. Having designed such a circuit originally led me to put in track feeders. I think I was probably the first one to put them in the ground some years ago. The result is that on elevated railways it will probably be policy to connect the rails to the iron girders. These iron girders, of course, are electrically connected by means of rivets to the posts, and these stand in the earth. On the other hand the concrete footings of the posts will cause a very high resistance in the path of the current, and I think if the girders are properly connected by bonds and the tracks are properly bonded that very little trouble would occur from elevated roads. It is a question of having metals of sufficient capacity so that the current will have no desire, as it were, to seek a path through the higher resistance, which is necessary to get into the earth. But the insulation of the tie, of course, is out of account, because the rails are likely to be connected to the iron girders electrically. On the Intermural road at the World's Fair the girders were placed on wooden posts and excellent work was done, but in actual city practice the girders are placed on iron posts. I believe it would be a mistake to put two wires overhead. I believe the return current can be taken care of underground. In large cities we are bound to come to it, and we will sooner or later overcome this difficulty by using the double trolley in conduits. But I do not agree with Mr. Abbott that we will ever use this double trolley overhead except under exceptional conditions. I have made that remark in the light of experience with both types of roads.

MR. RAU: The universal opinion is that the return circuit of a road is too small and that the road is built too cheaply. I do not think that has been the case in a good many places where trouble from electrolysis has been experienced. The road in Milwaukee has fully three inches in diameter of copper coming into the station for a return circuit, and although we are overcoming our trouble by connecting the pipes with the rails, I do not think any amount of copper added to the system would have avoided it.

Putting more copper into the ground is a very expensive method, and when a loss of 1-10 volt, as shown by Prof. Jackson's paper, will affect the pipe, it would require an enormous amount of copper to prevent so small a loss. To thoroughly overcome this action from railway currents I think if proper connections are made wherever the difference of potential is of such proportion as would cause electrolytic action, it would entirely overcome this trouble with very little expense, and certainly would be more satisfactory than to rely upon the street railway company to increase the return circuit until it overcomes it.

I am pleased to see that this idea of each company protecting its own system is being accepted by the telephone companies. At present in Milwaukee the company is making a series of connections to overcome the difference of potential between its cables and our tracks.

The return feeder is laid in a wood moulding, which is filled with a mixture of pitch and tar; this is pliable and will not get too hard in cold weather or soft enough to run in warm weather; this practically makes a cheap insulator for the wire and we find that it preserves the wire very well. After three years' use the wire was found in as good condition as when first laid.

## Milwaukee Street Railway Controversy.

The assessment on the street railway property of Milwaukee has been increased by almost $2,000,000. The street railway company has appealed from the assessment, and a fight in the courts that promises to be long and bitter is in progress. The company, as a result of the assessment, has abandoned the construction of all projected extensions and has stopped the sale of commutation tickets. The discontinuance of the transfer system may follow.

There has been no material change in the assessment of the street railway property which was assessed last year. The enormous increase in the assessment of the company's property is due to the fact that this year, for the first time, the franchises and tracks have been assessed. On the street railway company this assessment is $1,800,000, on the Edison Illuminating company $100,000, and on the Badger Illuminating company $200,000. Vice-president Payne appeared before the board of review, in company with counsel, and made an earnest protest against the assessment. He did not object to the assessment of the real property, but he did object to the placing of a tangible valuation on franchises. At one time, he said, he had considered the street railway franchises worth $2,500,000, but his ideas had gradually changed until the present time when he would not accept the franchises as a gift. He averred, however, that the franchises were worth untold millions to the city. In the case of the Badger Illuminating company, whose franchise is assessed at $200,000, he said that he looked to the early placing of a municipal electric light plant in the city, which would involve a loss of all the miles of conduits which the company had laid. The railroad company is bonded, and Mr. Payne was asked to explain the shrinkage. He told of the large amount of money which had been lost in experiments, and asserted that the earnings of the road were falling off at the rate of $10,000 a month. Then the company had paid from $2,000,000 to $3,000,000 for roads that were worth nothing. The purchases had been made at a time when there was a craze for converting horse car lines into electric lines. "It was thought," said Mr. Payne, "that all you had to do to make a fortune was to lay down two rails, put a trolley wire over them and run a car." He said that three years ago he would have been willing to get capital for a road from Milwaukee to Waukesha, while now he would not think of such a thing. He added that the company had wasted $400,000 in experiments and that motors which cost $3,000 then could be bought now for $1,000. If its franchises were assessed, Mr. Payne said, the company would have to go into bankruptcy or quit selling twenty-five tickets for $1 and issuing transfers. He incidentally remarked that he did not object seriously to paying a license fee of $15 on each car, but he did object to keeping the space between tracks in good condition. He said that the last exaction was a survival of the days of mule cars, and that electric cars did not injure the pavement in any way.

Mr. Payne admitted that before the final payment on the Becker line had been made, his company offered to give up all claim to $300,000 which it had paid if Mr. Becker would allow it to withdraw from the agreement for the purchase of the road and that Mr. Becker had not accepted the offer. "We bought at Mr. Becker's figures," said Mr. Payne. "We paid $350,000 for the Hinsey line, which is absolutely worthless."

When the board of review refused to revoke the assessment the company secured a writ of certiorari, which will bring the matter before the Supreme Court in September, and issued an order stopping the sale of commutation tickets. It also announced its intention of building no extensions this year at least. In a card to the public Mr. Payne stated that the average cost to the company of transporting passengers is more than four cents; that the expense

of operating the system is constantly increasing, owing to the city's requirements in regard to improving streets; that the earnings are decreasing, and that finally the increased assessment means $40,000 more taxes every year. On the previous Sunday, he said, there had been 18,000 transfers, and the company wished to extend that privilege to the public as long as possible. He concluded by saying that

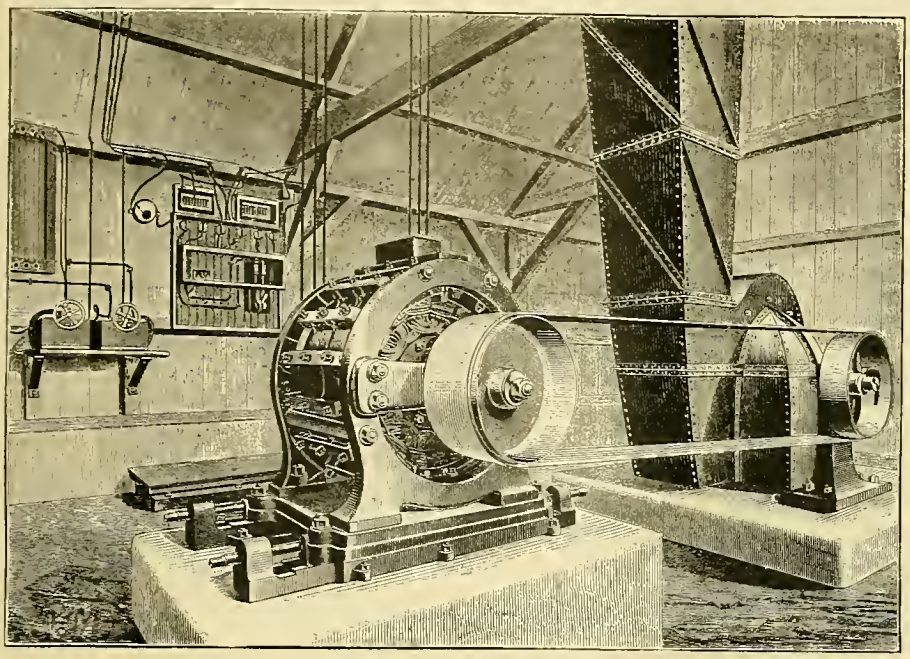


FIG. 3. ELECTRICAL TRANSMISSION OF POWER WITH TWO-PHASE CURRENTS.

five cents is the standard street car fare in the United States.

The manner in which the Milwaukee street railway lines were equipped with electricity forms a long chapter by itself. It is far too long to tell in the space that can be devoted to it. To be brief, the contract was lumped off to one company and at terms which were fixed just before the time for payment. In other words, the contract was let virtually without restriction to the Edison company, which was one of the biggest stockholders in the railway company, together with the North American company, which in turn was the biggest stockholder in the Edison company.

Money flowed like water, and all sorts of expensive machinery was purchased, devices which were mere experiments and are now lying at the power house unfit for use. The street railway company, though purchasing all the material, worked through the Edison company. It is impossible to tell of the many ways and means which were used for the wasting of money. Machinery which was never before used for street car work was put in the power house. Armatures especially built for the cars were constructed, and yet after all this bewildering lavishness, the power house in itself has been a partial failure, so the electrical experts say, and the company is beginning to realize the truth of the observation.

Of all the work, the construction and laying of the rails alone was done by the street railway company, and even then the material was furnished through the medium of the Edison company. The work on the roadbed was done by Milwaukee laborers employed by the street railway company and this work alone was performed at a reasonable cost.

The street railway extensions which have been abandoned as a result of the increased assessment are those of the Clybourn street line around the gully at Twentieth street west to the city limits, the Soldiers' Home line to North Greenfield and the state fair grounds, the Howell avenue line to Cudahy and South Milwaukee, and the Whitefish Bay dummy line farther north into the village of Whitefish Bay and its conversion into an electric line next spring.

Another clash between the city and the street railway company that will result in litigation is in regard to the street railway roadbed in streets that are being paved with asphalt. When asphalt pavements were first being considered General Manager Wyman of the street railway company appeared before the Board of Public Works and urged that it would never do to pave with asphalt the entire width of a street where there was a street railway, as the deflection of the roadbed would break the asphalt bed. The only practicable way, he maintained, was to pave between and alongside the track with asphalt. The board, after the contracts for asphalt paving had been let, came to the conclusion that the pavement would not stand unless a suitable foundation for the tracks were put down and it notified the company that it must provide concrete roadbeds on streets to be paved with asphalt. The city contracts, of course, provide for concrete beds for the asphalt, but the bed for the asphalt does not extend down so far as the sleepers of the tracks. The most serious difficulty is at the corner of Grand avenue and West Water street and the corner of East Water and Wisconsin streets. At those corners the company intends to put in curves both ways, which will cut the roadway into an infinitesimal number of small triangles and make it impossible to put down a bed of concrete between the tracks except above the sleepers, in which case the moving of the rails would be sure to let in the water and damage the asphalt. The Board of Public Works referred the matter to the common council, and Mr. Payne appeared before the council committee in opposition to the Board of Public Works and its recommendation to compel the street railway people to put down concrete roadbeds. The committee and the council, however, both supported the Board of Public Works. Unless the company begins the work by next Wedesday, the concrete roadbeds will be put in by the Board of Public Works and the cost will be charged to the company. The company is evidently not inclined to comply with the request of the city, and there is no doubt that the matter will be taken into the courts.

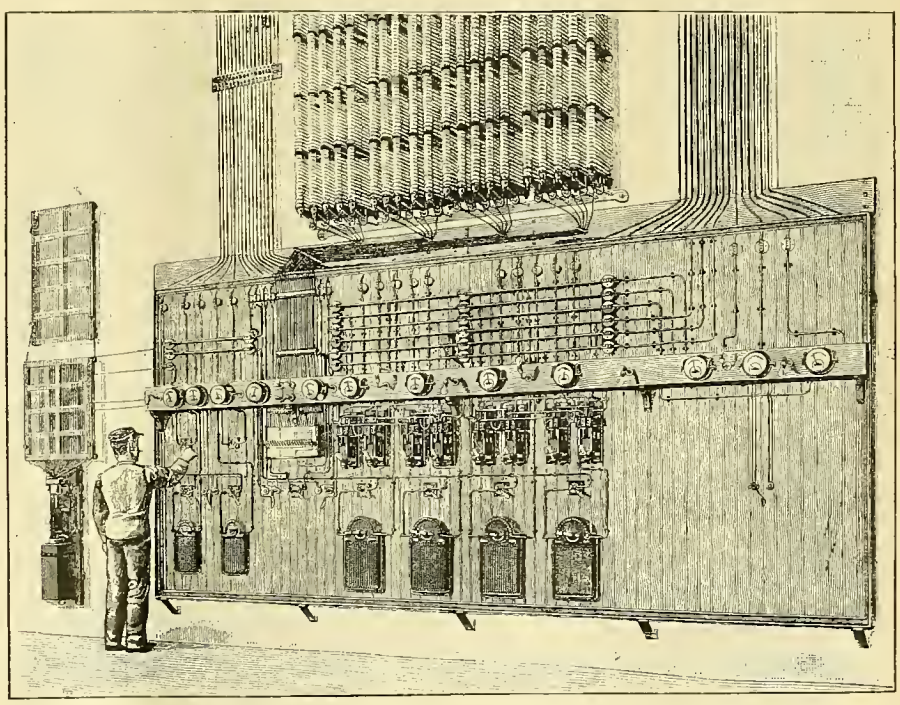


FIG. 4. ELECTRICAL TRANSMISSION OF POWER WITH TWO-PHASE CURRENTS.

## Bell Telephone Company Has a New Idea

Charles H. Aldrich of Chicago, ex-solicitor-general of the United States, has taken up the commendable work of showing up the American Bell Telephone company in its effort to secure patent legislation favoring its monopoly. Mr. Aldrich has prepared a petition to Congress, which has been presented by Representative Childs of Illinois, in which he vigorously opposes measures which are designed, he alleges, to extend the life of the Bell telephone patents which, from lawful causes, are about to expire. Four bills having this object in view, he says, have already been introduced in the House for the purpose of securing "the enactment by the present Congress of an amendment to Section 4,887 of the Revised Statutes of the United States, so that a domestic patent shall not be limited in its duration by the expiration of a foreign patent, unless the patent has been granted in the foreign country prior to the date of the filing of the application for the same in this country. In other words, it is proposed that time shall not commence to run against the monopoly created by a patented invention in this country, notwithstanding the people of every other country are free to use the same invention, by reason of the expiration of the foreign patents thereon, providing only the inventor had filed an application in the Patent Office before he took out his foreign patents." He goes extensively into telephone ligitation before the Patent Office, and declares that legislation anticipating judicial determination of questions now pending will cost the people many millions of dollars and perpetually fasten this monopoly upon the commercial interests of the country.

## Fire Chiefs' Convention.

The National Association of Fire Engineers, which is holding its annual convention at Montreal this week, will devote considerable attention to electrical subjects. Charles W. Ralph of Chicago will read a paper on "The Progress of Electricity in Municipalities," while Captain William Brophy of Boston will give the firemen "Some Points in the Transmission of Electric Energy" and Brown Flanders, superintendent of the Boston fire alarm system, will discuss "Dynamo Currents as Applied to Fire Alarms." City Electrician Barrett of Chicago and his wife are in attendance.

## Queen & Co. Assignment.

Under date of August 7th Queen & Co., Philadelphia, announce the suspension of their business and the appointment of a receiver. The following circular has been issued

Owing to the depression during the last year, and the difficulty in making collections, we have been compelled, in the interests of all our creditors, to make an assignment, without preference, for their benefit to our present manager, John G. Gray.

A meeting of the creditors for the purpose of determining the best method of disposing of the assets of Queen & Co., incorporated, will be held at the office of the attorneys of the assignee, Jones & Carson, rooms 426-431 Drexel building, Philadelphia, on August 13th, at 2 P. M.

Western Electrician.

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**CORRESPONDENCE** relating to electricity or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK
CIRCULATION, 16,630.

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IT is reported that William Steinway divided among charitable institutions his pay as a member of the Rapid Transit Commission of New York. Mr. Steinway evidently realized that he had not accomplished anything for the city and was not entitled to the money which was awarded him as commissioner.

DIRECT cable communication between France and her West India possessions is being agitated by M. P. Bordonnaut, formerly chief engineer of the French government telegraphs. It is estimated that a considerable reduction may be effected on the present rate for telegrams to the West Indies. From the French view point such a cable will be useful, not only as furnishing direct communication with the West Indian Islands, but also as assisting the French company, which already has a network of cables among these islands extending as far south as Brazil.

MR. ALDRICH, late solicitor-general of the United States, is entitled to the thanks of the public for directing attention, by a memorial addressed to Congress, to the obnoxious features of bills introduced into the House of Representatives to extend the duration of patents so that the protected period shall not be limited by the expiration of a foreign patent unless the patent has been granted in the foreign country prior to the date of the filing of the application in this country. All who have followed the phases of telephone patent litigation will realize the great and unjust advantage that would accrue to the American Bell Telephone company if this measure became a law. It would enable the company to continue its transmitter monopoly for several years longer, and add another blot to the already disgraceful record made by this corporation in dealing with the Patent Office and with the people of the United States. The past is bad enough; but it would be a public scandal to pass a bill plainly intended to still further entrench the position of this shameless monopoly. Now that public attention has been attracted by Mr. Aldrich, there should be no danger of such a calamity.

SPAIN has long been one of the most backward countries in the world in the matter of taking advantage of the advances that have been made in the applications of electricity. Recently, it is reported, there has been an awakening, and at the present time considerable activity is being displayed. The principal work is in electric lighting equipments and telephone exchanges. Several new central stations have been installed, and work is at present being done on others. In most cases the apparatus installed was made in Germany. Very little has been done until quite recently in the way of developing the telephone service, but now there are thirty-seven towns having exchanges, and, according to the foreign papers, new lines are being established in all directions. Among the latter may be mentioned an exchange about to be established at Mataro, a busy seaport town in Catalonia, about sixteen miles from Barcelona. At the same time a line will be run to the latter town, which will put Mataro in direct telephonic communication not only with Barcelona but also with Tarrasa, Sabadell and Manresa. It is also reported that an English syndicate capitalized at $600,000, has been formed for the purpose of acquiring possession of existing exchanges and extending the service.

NOT only electrical people but the general public, and especially users of telephones, will read with interest the statement made by Mr. Abbott before the Western Society of Engineers recently at Chicago, that the telephone companies were putting in complete metallic circuits in place of grounded circuits. This policy is in line with the best practice in other branches of the industry. Great advances have been made in telephony, but the benefits to be derived from many improvements could not be thoroughly enjoyed on account of the grounded circuit. Mr. Abbott says: "Nearly all the telephone companies are rapidly changing their lines from grounded circuits to metallic circuits, not only on account of the injury to which they are subjected from the other electrical companies, but also because experience has shown that the service obtained by the use of the individual circuit is attended with far better results. By this means each company secures a private right-of-way peculiar to itself, which not only does not interfere with other circuits, but is not interfered with by other circuits." Of course the additional cost of a complete metallic circuit will have to be provided for, but those who have had experience with both will not hesitate to substitute complete for grounded circuits.

ACCORDING to a press dispatch from Ottawa, Ont., the Dominion government has asked for propositions for the laying of a new Pacific cable and eight routes have been suggested. The distances over these several courses range from 6,030 to 7,175 miles according to the number of points at which landings are to be made. The most direct route is from Vancouver to New Zealand, touching only at Fiji. Several comprehensive systems are proposed, one of these including a line from Vancouver by way of Neckar, Fanning, Fiji and Norfolk islands with branches from Norfolk to New Zealand and Queensland. There are others equally comprehensive but with slight variations from this plan. One route that has many advocates proposes landings at Honolulu and the Gilbert and Solomon islands. This route has the advantage, too, of being comparatively short, the total distance being only 6,293 miles. It is provided in the specifications that the cable must be able to transmit at not less than the rate of twelve words a minute. Each offer must describe the character of the cable, its approaches, and cost of building, with provisions for repairs. Contractors shall specify the number of steamships required, which, together with the stores, are to remain the contractors' property for three years, when they will be taken over by the government at a valuation. Contractors are required to take all risks of landing places for the cable, the government undertaking to secure landing places at the several points mentioned. Interest in this project has been greatly stimulated during the last year and it is now confidently believed that something will come of the present movement.

IT is evident that the controversy over the levying of an assessment upon the franchises of the Milwaukee Street Railway company will prove a bitter fight. The board of review has sustained the tax commissioner's action and the street railway company has determined to fight the assessment in the courts. It is admitted that the action of the assessor in levying a tax on the company's franchises will have the effect of increasing the corporation's taxes threefold. In view of the fact that the company's receipts have been constantly decreasing during the last year the action of the city officials would appear rather harsh at this time. A statement of the company's finances made before the board of review showed that there was a large falling off in the earnings of the company for the month of July as compared with the same month last year. The company will find it necessary to discontinue the sale of commutation tickets and the practice of giving transfers, it is said, on account of the action of the city in placing this additional burden upon it. It has also been found necessary to abandon the plans for extending the system this year. As a matter of fact it would look as if the city would not come out of this controversy with much glory. However, the city council has come to the aid of the assessment bureau and an agitation for municipal control of street railway and lighting plants has been begun. This is a favorite scheme of the Milwaukee aldermen, and those who have followed the proceedings of that body during the last few years are not inclined to look seriously upon this movement. On August 6th the council adopted a resolution authorizing "the commencement of negotiations for the purchase of the property of the Milwaukee Street Railway company, which includes not only all the street railway lines in the city, but also the plants formerly controlled by the corporations known as the Badger Illuminating company and the Edison Electric Light & Power company." Milwaukee has justly earned the reputation of being one of the most conservative business towns in the country, but a few more indiscreet acts like the policy adopted in dealing with the street railway company will seriously jeopard the city's reputation.

ANOTHER feature of interest in the dicussion over the action upon water mains and gas pipes of electric currents from street railway systems is the legal view of the case. Already the lawyers are speculating on the probable position of the courts on this subject. Writing in the *Street Railway Gazette*, R. D. Fisher says: "It is certainly true, as the courts have generally held, that no one mode of public service has a right to monopolize the earth or the air of a public street, but the power of injunction will only be exercised so as to avoid present injury to existing property until scientific and practical men find a way for all to operate in harmony free from negligence and wanton injury. Whether the power of restraint will be exercised even to this extent against electric railway companies for the use of water companies is not yet settled, and it may be that the courts will decide that in these particulars each and every company using the streets must exercise care and ingenuity to protect itself from the effects of intrusion by a neighboring system for lawful ends and by legitimate means, only insisting that each must use the best and most improved appliances practicably available for producing the best results and the least disturbance." It will be well to bear in mind that in the litigation over the respective rights of the telephone and street railway companies to use the streets, the courts generally took the view that when the railway company's wires interfered with the telephone system the street railway company was bound to make good any loss that had been sustained. It is now pretty well established that no single interest can monopolize a street, and while the street railroads have an undoubted right to occupy the public thoroughfares they cannot destroy other property or inflict damages without making ample compensation. This question will no doubt be passed upon at an early day, for the complaints are numerous against the street railway companies, and it is not to be expected that gas companies will submit to the destruction of their property without protest. It is of course impossible to predict the outcome of this matter, but it would seem that all parties concerned should bestir themselves to find a practical solution of the problem.

# Test of a Closed-coil Arc Dynamo.[1]

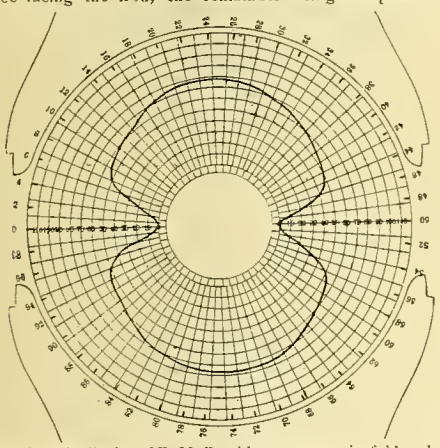
By Prof. R. B. Owens and C. A. Skinner.

That so much has been said and written concerning the design of constant potential machinery, effects of armature reactions, control of sparking, etc., and so little concerning the machinery used for arc lighting, seems rather remarkable considering the fact that by far the larger part of our outside lighting as well as much inside lighting is done by means of arc lamps in series; and I hope a discussion will follow in which more light will be thrown on the principles of design of arc machinery, for at present there seems to be much empiricism in the matter.

The immediate object of the present paper is to show something of the nature of the armature reactions which occur in arc light machines of the closed-coil type, maintaining constant current by automatically shifting the brushes to correspond with changes in load in the external circuit, and to point out certain alterations in design which it is believed may be adopted with advantage. Incidentally other points will be noted. Of course there are other well known methods of maintaining the current constant—notably by shunting the field magnets, as in the Brush machine, or a combination of this with shifting the brushes, as in the new Excelsior machine, or by varying the length of time per revolution during which the armature coils are in series and shunt to each other or short-circuited, as in the Thomson-Houston machine; but these will not be considered at present. Nor is it intended here to discuss the relative advantages of the several types, but only to give some results obtained in a test of a closed-coil machine regulating as mentioned. Such machines are now taking a prominent part in the arc lighting industry, and their prominence merits for them more close study. Alternating current dynamos, as the Westinghouse arc light machine, have been devised which keep the square root of the mean square of the current remarkably constant through extremely wide variations in load and without any external regulating mechanism whatever. They possess many advantages, but are not now widely used, for arc lamps seem as yet to work more satisfactorily on continuous current circuits. We believe it is also possible to build continuous current arc machines which by armature reactions alone can keep the current very nearly constant throughout a considerable range, but it would seem that their cost would be more and their efficiency less than in some of the types using an external regulating mechanism, although we have no exact comparative data.

The machine on which the following experiments were made is a No. 6 25-light 2,000 candle power Wood arc dynamo, a scale drawing of which is shown in Fig 1. From the drawing all dimensions, as of magnet limbs, yoke pole-pieces, armature, etc., are at once seen, its designer, James J. Wood, most courteously consenting to my giving the name of the machine tested and its full data.

The winding data and other details, as furnished by the makers, are as follows. The field magnet winding is composed of four coils of No. 10 B. and S. gauge copper wire single cotton covered. The outside diameter when insulated is 0.114 inches. Each coil contains 100 pounds of wire in 15 layers of 74 turns each. The insulation of the magnet cores is ⅛ inch thick, and composed of one layer of enameled cloth, the enameled surface facing the iron, the remainder being composed of



Showing distribution of E. M. F. with 10 amperes in field and no current in armature.

FIG. 2. TEST OF A CLOSED-COIL ARC DYNAMO.

pressboard 0.025 inch thick. The magnet heads are wooden washers 5-16 inch thick, carefully dried and shellacked. The armature core is composed of No. 10 B. and S. gauge annealed charcoal iron wire. This is wound on a former, which is removable, and is composed of 15 layers 6¾ inches wide. These wires are held together by interposed strips of linen tape. The core is then insulated with a layer of asbestos paper, three thicknesses of pressboard 0.15 inch thick, one layer of asbestos paper again, and then over this one more layer of pressboard 0.15 inch thick, making a smooth surface for the copper wires to be wound on. The insulations near the spider arms are built up of the same material and in the same manner as the armature core, until they attain a thickness of ¼ inch. The armature is wound with 100 sections of No. 14 B. and S. gauge double covered cotton wire. Each section is composed of 93 feet, or 57 turns per section, making a total of 115 pounds of wire. The regulator magnet is wound with No. 11 single cotton covered B. and S. gauge wire, in the manner shown on the dynamo; the insulation of the cores being 5-32 inch thick, and that of the magnet heads 3-16 inch, while the speed of the dynamo is 1,000 revolutions per minute.

1. Read before the American Institute of Electrical Engineers, Philadelphia, May 16, 1894.

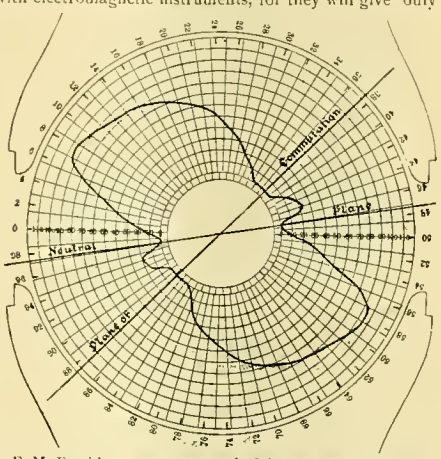
### Conditions of Test.

The dynamo was securely bolted to a firm foundation of masonry, and driven through a 7 inch belt by a small 8 inch by 10 inch high-speed automatic Atlas engine making 250 revolutions per minute. Steam was supplied at as nearly constant pressure as possible. The automatic regulator of the dynamo was removed, together with one pair of opposite collecting brushes, and the remaining pair reduced one-half in width parallel to the commutator bars, to allow of easier manipulation of the exploring brushes, their angular width being of course adjusted for each load to prevent sparking.

It was at first attempted to use a number of arc lamps as load for the dynamo, but though carefully adjusted and using cored carbons, the variations of potential and current due to their feeding was greater than could be admitted, so the lamps were discarded for two water rheostats 4 feet by 1 foot by 1 foot, with carbon electrodes. These latter on the whole were found to work quite satisfactorily; their resistance hot was considerably less than when cold, but it changed so gradually that no trouble was experienced in correcting for it by adjusting the electrodes.

The distribution of the induction entering the armature at different loads was obtained by taking the electromotive force at various points on the commutator between two small pilot brushes moved around and in contact with it.

The two-brush method, though somewhat more difficult to work than the single-brush method, has the advantage over the latter of giving the quantities sought directly, instead of as a difference between quantities which are large as compared with those desired. In some cases the integral readings of the brush method have been plotted, but curves so obtained do not indicate so clearly what is mainly sought, namely, the distribution of lines of force entering the armature. True, one curve can be approximately obtained from the other if electrostatic instruments are used, but not with electromagnetic instruments, for they will give only a




E. M. F. with 10 ampere current in field and armature, 25 light position.

FIG. 3. TEST OF A CLOSED-COIL ARC DYNAMO.

mean electromotive force depending on the relative width of a commutator bar and insulation and distance apart of the pilot brushes. The results obtained, however, with a voltmeter of the Weston type are proportional and for the present purpose are equally valuable.

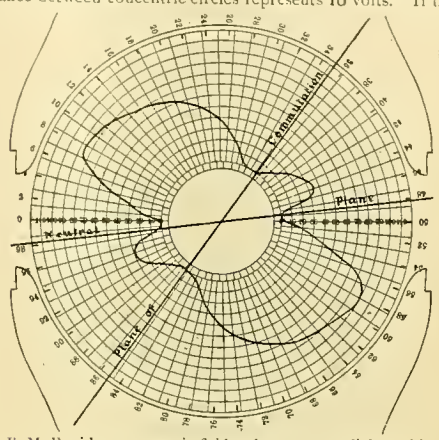
The exploring brushes as finally used were pieces of steel watch springs firmly held in small fiber holders. These, in turn, were rigidly secured by brass studs to a graduated sliding ring, moving within another stationary ring attached to and insulated from the dynamo frame and carefully centered with the commutator.

Two brushes were used in each holder to better insure good contact. Copper, brass and phosphor-bronze exploring brushes were tried at first, but found not as satisfactory as steel. It was also found very necessary at all times to keep the brushes and commutator as clean as possible.

The sliding ring was marked off into one hundred divisions, the number of commutator segments and the exploring brushes made to cover just two commutator bars or one-fiftieth of the circumference, but the ring might have been divided into degrees if desired. The curves shown in Figs. 2, 3, 4, 5, 6 and 7 are plotted so that the results may be read either in degrees or in divisions of the graduated ring.

The inner circle representing the commutator of one hundred segments and the 100 divisions of the ring are marked on the outer circle.

The radial lines are 5 degrees apart, and the radial distance between concentric circles represents 10 volts. If the




E. M. F. with 10 amperes in field and armature, 20 light position.

FIG. 4. TEST OF A CLOSED-COIL ARC DYNAMO.

results had been plotted on a developed diagram, then the areas of the curves would have represented total or integral electromotive forces, but the circular diagram has the advantage of appealing more quickly to the eye, and though the total electromotive force is not exactly represented by the area it is proportional to the number of the small approximate rectangles enclosed. In obtaining efficiency measurements the power delivered to the dynamo was obtained by indicating the engine. The cards were taken with a Tabor indicator and worked up with a Coffin averaging instrument, the speed was obtained by a speed counter and stop watch. The electrical instruments used were a Weston 0.15 amperemeter for current measurements, a Weston 0.15 and 0.150 voltmeter for potentials between pilot brushes and a 0.150 and 0.1500 Weston voltmeter for total electromotive forces. All instruments were previously calibrated.

### Results Obtained.

Fifteen sets of readings, fifty readings per set, were taken around the commutator with currents in armature and field of 8, 10 and 12 amperes, at positions of the collecting brushes approximately corresponding to loads of 5, 10, 15, 20 and 25 lights. Three sets of readings were also taken with currents in the field of 8, 10 and 12 amperes and no current in the armature. The results obtained are given in tables (not printed), and for a current of ten amperes are plotted in corresponding plates.

The reactions of the armature are so clearly shown by the curves that comment hardly seems necessary. Briefly, we see that the total induction in armature varies very slightly with lead and the displacement of the neutral plane decreases with lead angle, but varies less than 10 degrees from no load to the maximum load used.

All electromotive forces on one side of the neutral plane are of the same sign, but differ in sign from those on the opposite side.

On a developed diagram the electromotive forces between collecting brushes would be proportional to the difference between the whole area of curve on one side of the line of commutation and the area of the curve included in the angle of lead, the lead angle being defined as the angular

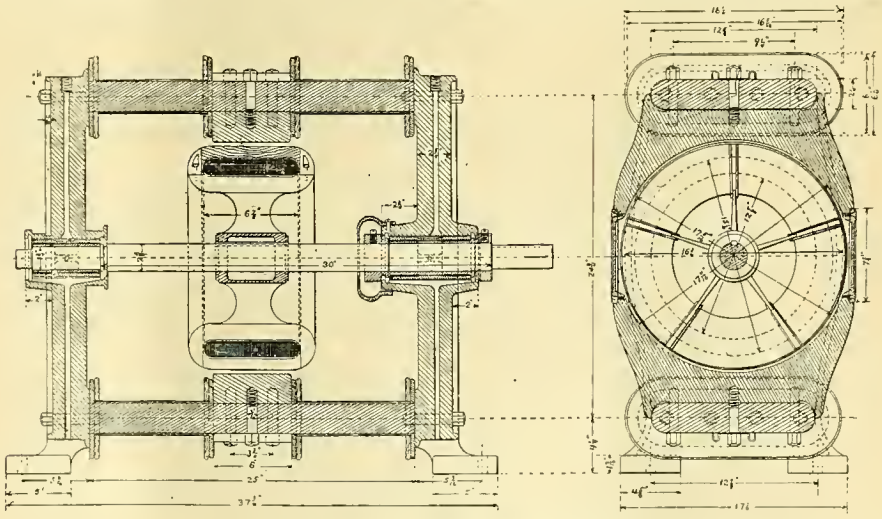


FIG. 1. TEST OF A CLOSED-COIL ARC DYNAMO.

advance of the collecting brushes from the neutral plane. An inspection of the curve of total electromotive force with angle of lead given in Fig. 6 shows that the electromotive force between neutral points remains nearly constant as lead varies, which it is believed would not be the case if contracted polar faces were used instead of the extended ones as shown, for then the shifting of the field could not be so easily effected. Of course a machine of the design tested with extended pole tips requires an automatic widening of the brush

with increased load or in dependent control of sparking, but it would seem that the waste field at all loads would be less and its weight efficiency greater or cost for a given output less than if its pole tips were cut away. Cutting away the pole tips, or at least not extending them, would have the advantage of allowing the use of collecting brushes of constant width within a certain range, but whether this advantage more than compensates for the decreased range of its output is open to question. Further experimental evidence is, however, needed in this regard.

Regarding the relative amounts of iron in field and armature, we see no reason for the present practice of using so little iron in the armature, as compared with the field. The necessity of a very high field induction or a thoroughly stiff field is apparent; but why, when the lines are once generated by the field, it is not sought to collect and utilize them all by means of an armature with a generous amount of iron, is not so easily seen. The number of commutator segments would of course have to be increased to prevent sparking, but the regulating qualities of the machine, it is believed, would not be impaired. The result would be a larger output and greater efficiency.

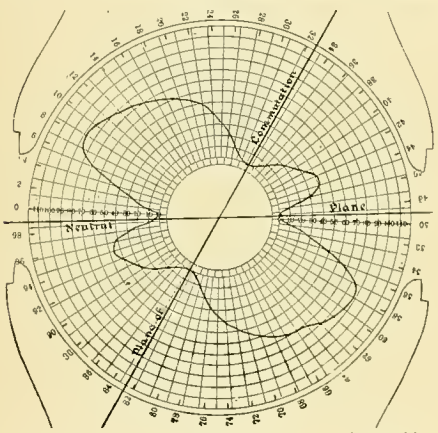
Regarding the ratio of ampere turns on field and armature, such ratio will depend largely on the shape of the pole pieces and desired width of brush, but is in all cases much less than in constant potential machines.

The characteristic curves shown in Fig. 9 were taken at the 5, 10, 15, 20 and 25 light positions of the brushes, and show that with this machine regulation is almost entirely effected by shifting the brushes, as the curves droop too slowly to assist to any material extent. Of course they might have been made to droop much more rapidly if the collecting brushes had been moved into sparkless positions for each value of the current, but a curve so obtained is not at all a characteristic. The efficiency curve is given in Fig. 10. From this curve and from what we have seen of the machine it is evident that it would never pay to run machines of this type underloaded. If a number are used in one station the connections of the external circuits at the switchboard should be so manipulated as to keep the machines actually in use always loaded to as near their full capacity as possible.

Our thanks are due to H. J. Podlesak, who greatly assisted in taking the observations and working up the results.

## New Municipal Lighting Station, Chicago.

Plans are now in course of preparation for the new municipal arc lighting station for the West Side, Chicago. This station will be on Blue Island avenue, near Halsted




E. M. F. with 10 amperes in field and armature, 15 light position

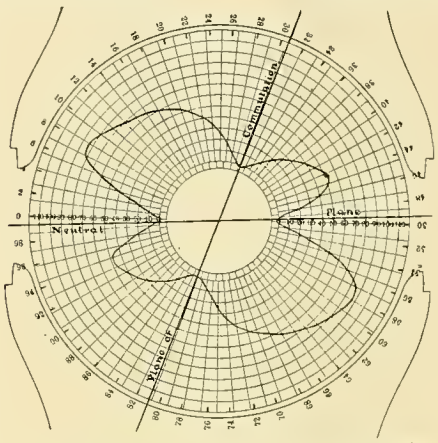
FIG. 5. TEST OF A CLOSED-COIL ARC DYNAMO.

street, and will supersede the old Throop street station, which was sold by the city to the Metropolitan West Side Elevated Railroad company as a portion of the latter's right-of-way. The new station is designed to have an ultimate capacity for supplying 2,000 arc lamps of 2,000 nominal candle power each, but at first will be supplied with dynamos for but 600 lamps. The steam generating plant will consist of three Heine boilers, each having a normal rating of 500 horse power. The engine contract has been secured by the Ranken & Fritsch Foundry & Machine company of St. Louis, which will supply two Corliss compound condensing engines of 600 horse power each. The shafting will be furnished by the Hill Clutch Works of Cleveland. The electrical equipment has not yet been purchased. A dynamo capacity for 600 lamps will be put in at the start, one engine being kept as a relay. Beside the load formerly carried at Throop street, a number of new circuits of street amps will be operated from this station.

## Ghostly Electricity.

The prominent place taken by electricity in every-day life during the last dozen years has brought out many queer stories of what are esteemed the vagaries of a force which is still mysterious to the great public. Careful investigation usually shows a simple cause for the strange phenomena, if, indeed, the details are not elaborated by sensational writers. To what inspiration is due the following tale, sent out from Baltimore, the reader must be left to judge:

Mysterious electrical disturbances have terrorized Henry Kontschoosky, a tailor, and his workmen and family, at their home in Bond street, for the last three days. Suddenly, on Saturday morning last, the three-story building shook as from an explosion. The tailor and his ten helpers fled in fright to the street. No one outside had felt the shock. The disturbance was followed by fire in the floor and washboards of the shop. The fire was quickly extinguished and the men returned to work. Later the water pipes were found to be leaking. A plumber on examining them found that the solder had melted where the house pipe joined the main pipe in the street. Next morning the house again shook. A workman sitting with his back against a gaspipe received a severe shock. The waterspout down the front of the house fell to the ground in pieces, the solder having melted from the joints. The washboards and floor of the house again took fire. Blue flames shot



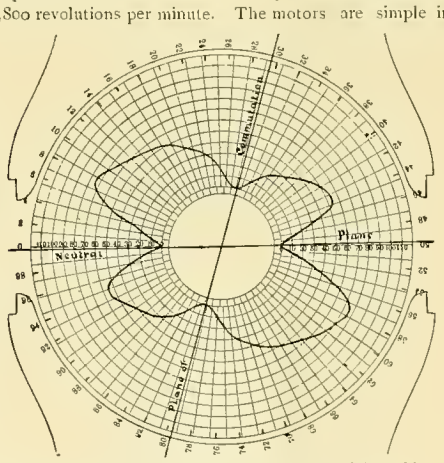

E. M. F. with 10 amperes in field and armature, 10 light position.

FIG. 6. TEST OF A CLOSED-COIL ARC DYNAMO.

through the crevices in the cellar wall. The whole place was heavily charged with electricity. A crowd collected in front of the house. The tailor, his workmen and family, would not return indoors. Several electricians began an investigation. The electrical cars pass the door, and electric wires cross the roof. There is no break, however, in the connections, and the electrical experts are puzzled at the phenomena.

## A Tri-phase Electric Fan.

In the accompanying illustration (Page 81) is shown a tri-phase electric fan motor, the necessity for such an article having arisen in Concord, N. H. The Concord Land & Water Power company, which is the only concern supplying the city with electricity, recently put in a three-phase current generating plant to supplant its direct current machines. Users of electric fan motors found their apparatus of no value, and there were no three-phase fan motors upon the market. A. L. Cushman of the Granite State Electric company of Concord designed and built the motor illustrated, which met admirably the local conditions. The motors are of ¼ horse power capacity and are very neat in appearance. They are mounted upon five-inch bases and are not over 8 inches in any diameter. They take one ampere on a 110 volt circuit and carry a 16-inch fan at about 1,800 revolutions per minute. The motors are simple in




E. M. F. with 0 amperes in field and a mature, 5 light position.

FIG. 7. TEST OF A CLOSED-COIL ARC DYNAMO.

design, dispensing, of course, with commutators, collecting rings or brushes. It is believed that this is one of the first, if not the first, three-phase motors to be built in this country for fan moror purposes or of such small capacity.

## Armored Insulating Conduit.

The illustration on page 81 represents a new telescopic insulating conduit with iron armor for underground work. The telescopic arrangement, whereby lengths of plain insulating conduit are slipped into lengths of the iron armored insulating conduit so that the sections break in the centers of the lengths, gives a double insulation and at the same time an iron armor for protection. The lengths are coupled together by straight threading the ends and abutting them in the center of the coupling, thus producing an underground conduit that is waterproof, durable and possessing high insulating qualities—so high in fact that bare wires may be drawn in with confidence. This system is complete in details, including junction boxes, etc., and is

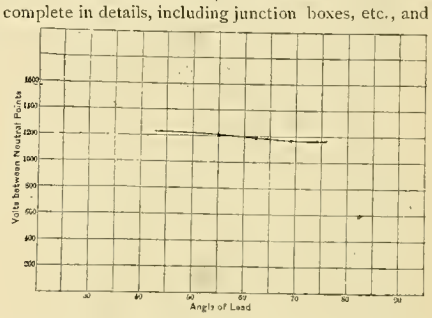



FIG. 8. TEST OF A CLOSED-COIL ARC DYNAMO.

now in use in the underground construction of the John on-Lundell electric railway at East Sixty-ninth street and First avenue, New York. It is an addition to the underground conduit system of the Interior Conduit & Insulation company of New York.

## The Manufacture of Armature Disks.

The three accompanying illustrations show some improved machinery made by the E. W. Bliss company, 14 John street, Brooklyn, N. Y., largely used in the making of armature disks for electrical machines. Fig 1 represents a No. 95 double Pitman press, and is used for blanking out rings for disks, which is usually done in a combined double die, cutting the inside and outside ring at the same stroke; this leaves a plain ring ready for the No. 61 notching machine represented in Fig. 2. There are some

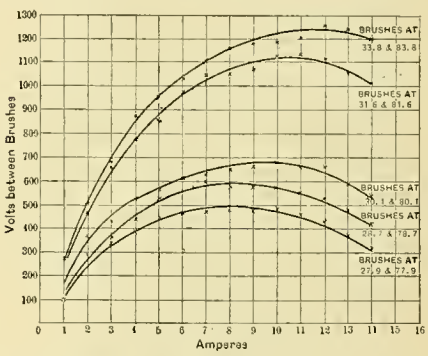



FIG. 9. TEST OF A CLOSED-COIL ARC DYNAMO.

firms which punch the notches in these disks at the same stroke that the center is cut, by this method making a complete notched ring at every stroke of the press. This method, however, calls for such fine, delicate dies which are so expensive that it is not of general use, it being much cheaper to make the plain punched ring and then put it in the No. 61 press. This press has an accurate dial feed carrying the blank under the notching die and cutting from one to six notches at a time as may be desired. The disk is easily placed in position and held by adjustable clamps. After the notching is done the disk is easily removed. This press can also be arranged so that as the last notch is punched it will stop itself automatically. It is adjustable to different diameters ranging from 12 up to 48 inches; all its motions are well designed for their purpose and all the working parts are accessible and in

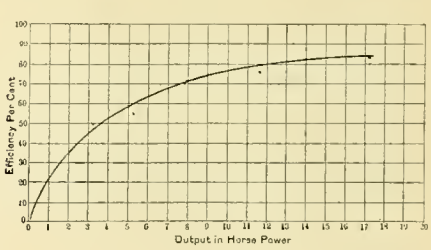



FIG. 10. TEST OF A CLOSED-COIL ARC DYNAMO.

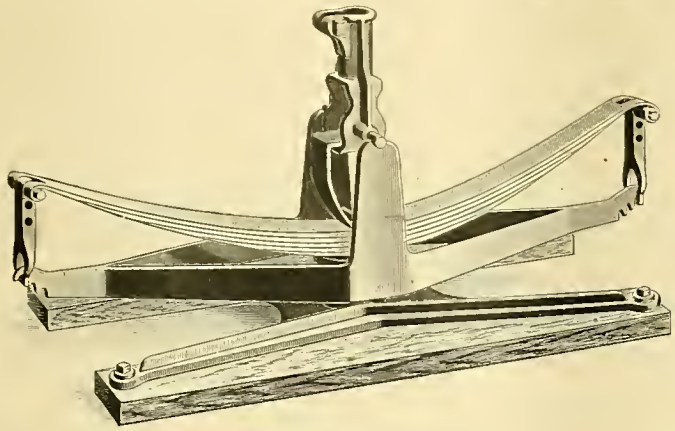
sight. There is a large number of these machines now in practicable use and giving excellent satisfaction.

The smaller machine, Fig. 3, is of recent design, and is intended for rolling down the burrs sometimes caused by the wear of the dies and punches, thus leaving a slight roughness on the blanks punched. After such blanks or sections are passed between the rolls they are quite smooth and will lay close to each other and pack tightly when

used in a dynamo or other machine. This rolling machine has all the needed adjustments, etc., that are necessary for the proper performance for its work. The manufacturer will be pleased to furnish any further information with regard to these machines. Of course there are considerably larger machines used in this work, but this is the most popular size.

## The Ohio Trolley.

The Ohio trolley, manufactured by the Ohio Brass company of Mansfield, O., as shown in the accompanying illustration, is one of the simplest and most effective on the market. It is made up of less than a dozen pieces, any of which can be easily duplicated. The spring is the regular flat leaf style, such as any manufacturer of carriage springs keeps in stock. The working parts of the trolley are made of steel and malleable and wrought iron, and in consequence are not easily broken and do not get out of repair. The base and stand are three feet long and eight inches wide, and when the trolley pole is in a horizontal position but 13 inches high. The trolley pole can be swung either forward or backward or in a complete circle, and the pressure against the trolley wire diminishes as the pole assumes more nearly a horizontal position. The trolley can be assembled or dismantled in a few minutes without the aid of tools. It is very easy and flexible in action, and will follow the variations of the trolley wire quickly and surely. In fitting these trolleys out complete, the Ohio Brass company uses its special carbonized steel trolley pole. This pole is drawn cold through a die and is made of the best Norway iron. It is then carbonized to the proper degree to give it sufficient elasticity. It is seamless and endless, and formed to a perfect taper. The claim made for this pole is that it is lighter, more flexible and stronger than the regular style trolley pole. It will not break, and if bent out of shape can be straightened cold without injury. This pole is one of the specialties of the Ohio Brass company, which it is now pushing into the market with marked success.



THE OHIO TROLLEY.

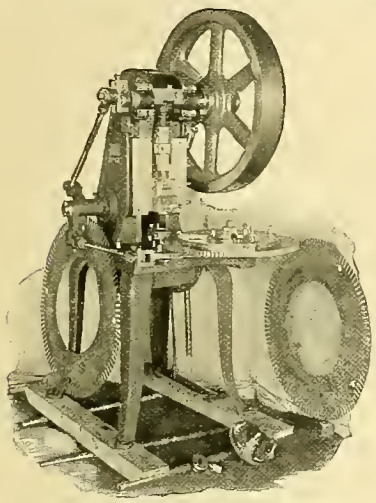


FIG. 1. THE MANUFACTURE OF ARMATURE DISKS.

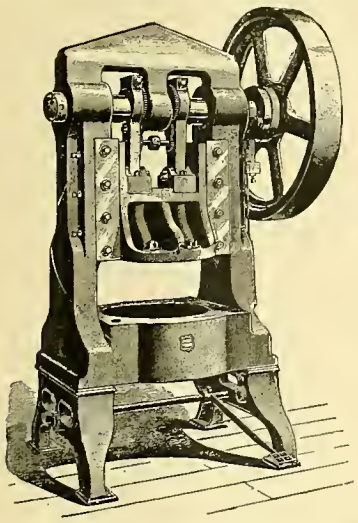


FIG. 2. THE MANUFACTURE OF ARMATURE DISKS.

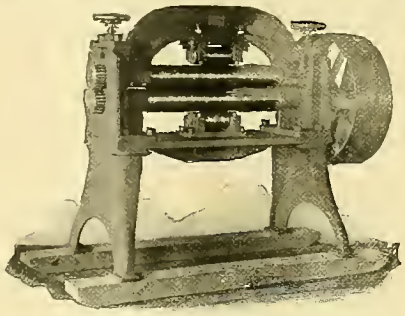
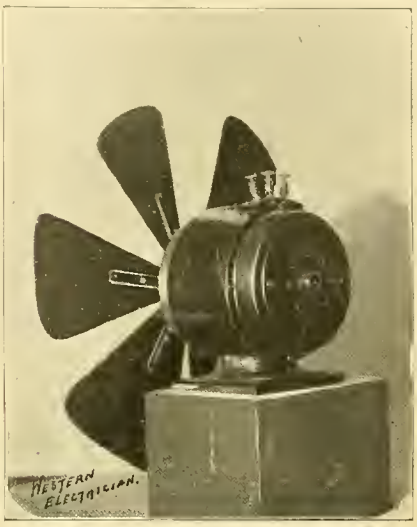


FIG. 3. THE MANUFACTURE OF ARMATURE DISKS.

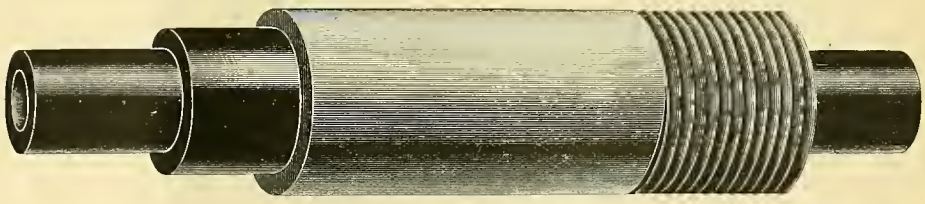
## Engine-dynamo for Shipboard Use.

The small marine generating set herewith illustrated has been recently placed on the market by the General Electric company. Combinations of this type are made in four sizes—15, 30, 40 and 50 kilowatts. The engine is of the automatic cut-off type, double and vertical, and is rated on a basis of 80 pounds initial steam pressure at one-quarter cut-off. This leaves a liberal reserve capacity above the rating given, and the engine can be run under any steam pressure between 60 and 100 pounds. All the parts are accurately cut, so that in case of necessary repairs delay in fitting is avoided. The crank shaft is of hammered Bessemer steel made in one piece, while the connecting rod is of forged steel with babbitted boxes. The cross-head is of a crucible steel casting with babbitted wearing surfaces, and the main bearings are provided with interchangeable babbitted cast iron boxes, and are of extra length.

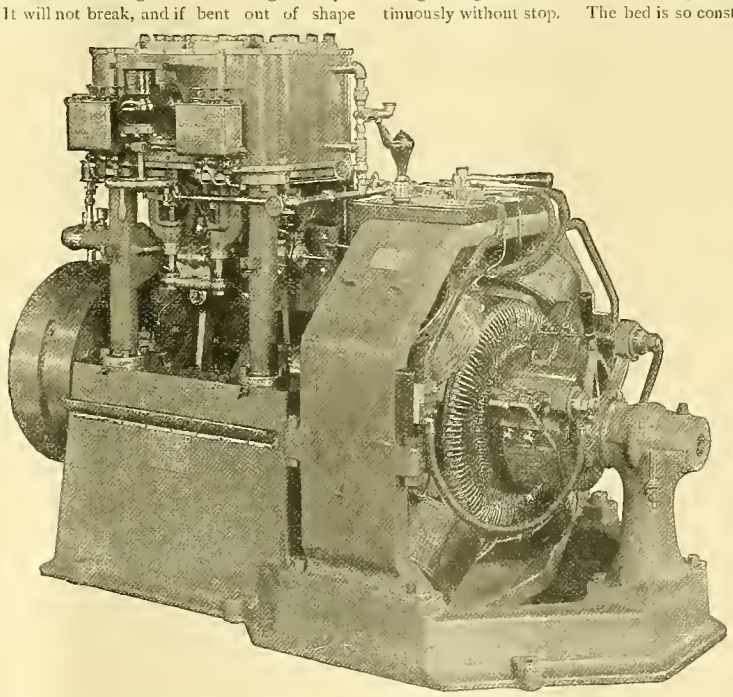



A TRI-PHASE ELECTRIC FAN.

The dynamo is well protected with oil guards, and the oiling arrangement is such that the engine may be run continuously without stop. The bed is so constructed that all the waste oil is collected in one pit, from which it may be drawn, filtered and again used. The governor is of very simple construction; its parts are readily accessible, and are



ARMORED INSULATING CONDUIT.



ENGINE-DYNAMO FOR SHIPBOARD USE.

always in sight. All those parts of the combination subject to wear are made of hardened tool steel.

The variation in speed from extreme light load to the full capacity of the dynamo does not exceed four per cent. The connection between the engine and dynamo is made through a solid flange coupling especially constructed for a ready and easy disconnection of the armature. The armature is of the smooth body type, and the entire load may be thrown on without shifting the brushes and without sparking.

## Rumored Trust in Insulating Materials.

It is reported that a combination is being arranged between some of the large manufacturers of insulation materials. It is said that hard rubber fiber and some of the other well-known compounds will be included in the trust.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, August 13.—The trial trip of the new postal trolley cars, designed to facilitate the free delivery of the mails between Brooklyn and Coney Island, was made on August 8th from the entrance to the postoffice on Adams street and was regarded as a success. It is the opinion of Postmaster Sullivan that the collection and the delivery of the mails will be expedited by several hours by the new system. The two postal trolley cars are built on the same plan. They are painted white with gold lettering. The interiors of the cars, which are 28 feet long, are divided into two compartments each 10 feet long. The postoffice apartment resembles the interior of the ordinary postal car. There are frames for mail bags on one side and on the opposite side is a wide table and a case of 40 pigeonholes, by means of which the mails are distributed. The other section is used as a smoking apartment. Postmaster Sullivan says he will extend the system to the other trolley lines wherever opportunity presents itself. He would also like to have a drop box on every car on all the lines throughout the city, as the most of them pass the postoffice. By this means there would be a continuous collection of mail matter.

The Nassau Electric Railroad company has been informed that it must verify to the city works department the consents of property owners in all streets where permits for the work of erecting trolley poles and laying car tracks were secured last year. It was recently found that the needed number of consents had not been secured in South Fifth street and the work was stopped.

Hackensack is disturbed over the introduction of the trolley street electric system. About two weeks ago President Andrew Zabriskie of the Bergen Turnpike company intimated that a trolley line would soon be built by the company. He intimated also that the town authorities had little to do with the matter beyond the designation of the style of trolley roads and the streets that should be used for them. The citizens of Hackensack have conceived the idea that the plan of the trolley system on the turnpike was made in the interest of the company that controlled the road and that it was really the plan to turn the road over to the big traction company which controls a large part of the electric systems of New Jersey. The turnpike company has some obligations which stand in the way of negotiations for the right of way for the trolley line from Rutherford to Hackensack. However, the right of way is assured from Rutherford to Hasbrouck Heights, half a mile away from Hackensack. Beyond this point the property owners are solidly opposed to the trolley system. The idea prevails that the managers of the trolley system contemplate tapping all the small towns in the valley of the Hackensack north of the county seat across to Englewood and extending northward and southward to the northern valley west of the Palisades. From Hackensack to Rutherford the line would connect with the Paterson plank road line to Passaic and Paterson, extending south to Newark and connecting there with the line to North and South Orange. The Hackensack people bitterly oppose the construction of the road. They assert that the main street is not wide enough for a street car track, and moreover, that the street having been macadamized, ought not to be torn up with a track. It is proposed to have a public meeting of interested citizens in the part of New Jersey which would be affected and let them discuss the question in all its aspects.

W. F. O.

## PERSONAL.

Edward R. Grier has returned to Chicago after a four weeks' trip in the East.

Louis A. Ferguson of the Chicago Edison company is in the East enjoying a well-earned vacation.

Charles H. Rudd of the Western Electric company, Chicago, who was injured in the explosion which occurred while he was experimenting with one of his inventions, died in the Presbyterian Hospital last week. Mr. Rudd was well-known and universally popular in electrical circles, and a large number of friends will deeply regret the fatal termination of his injuries.

Hon. George B. Shaw, well known in electrical circles, is confined to his bed by a serious attack of malarial fever at his home in Eau Claire, Wis.

Prof. J. P. Barrett, city electrician of Chicago, is in attendance at the annual convention of the fire chiefs of America at Montreal. He is accompanied by Chief Swenie of Chicago.

W. S. Andrews has resigned the management of the Lancaster, Pa., and other central stations with which he has been connected and has accepted a position with the General Electric company at Schenectady.

## ELECTRIC LIGHTING.

The three-phase system has proven such a success at Sewall's Falls, Concord, N. H., that a large generator has been ordered for the city of Franklin for the distribution of light, heat and power. There is abundant water power at that place; one river, the Winnipesaukee, falls nearly 200 feet within two miles.

The Galesburg, Ill., Gas & Electric Light company has purchased from the General Electric company two 60 kilowatt dynamos of the new monocycle type. The machines are wound for 1,000 volts and will be used for lighting and power distribution. This is said to be the first installation in the West of monocycle generators.

The Hyde Park Electric Light & Power company has secured an injunction protecting its wires at State and Sixty-first streets, Chicago, from interference by the city. The city claims that the Hyde Park company has no right to furnish power outside the town of Hyde Park. Affidavits are on file stating the People's Electric Light & Power company is doing this and is not interfered with.

The name of the Cleveland General Electric campany, Cleveland, has been changed to the Cleveland Electric Illuminating company. The company furnishes current for arc and incandescent lighting and for power. The current for incandescent lighting is furnished on a meter basis at the rate of 12½ cents per 1,000 watt hours, from which rate a cash discount of 10 per cent. is allowed if accounts are paid within 10 days of the date of the bills, rendered monthly. The net rate, therefore, is 11¼ cents per 1,000 watt hours.

Property has been purchased at Edwards Falls, near Manlius, N. Y., and it is proposed to establish an electric light plant there to supply the villages of East Syracuse, Eastwood Heights, Fayetteville and Manlius. There is a stream capable of furnishing several hundred horse power in the town of Manlius that is not utilized. The village of Elbridge, in the west end of the county, has an electric light plant operated by water power and it has proven a paying investment. The Elbridge works also supply the village of Skaneateles. Elbridge, it is said, is the smallest village in the United States that is lighted by electricity.

## ELECTRIC RAILWAYS.

There is some talk of the organization of a Canadian Street Railway association.

Serajervo, Austria, it is said, is to run an electric light and railway plant on the municipal plan.

Nijninovgorod, the great Russian market town, is to have an electric railway on the overhead plan.

It is announced that the Adrian, Mich., Electric Belt railway has been sold to Philadelphia capitalists.

A company is being formed to connect Crisfield, Md., Mariners, Asbury and Abes Hole with an electric road.

The Supreme Court has decided that the Denver, Colo., Tramway company's original franchises for cable and electric lines are valid.

The Winona, Minn., General Electric company has made satisfactory arrangements for extending its lines. A. H. Hill has been appointed general manager.

It is said that the purchasers of the Maryland end of the Baltimore & Lehigh railroad are contemplating changing the operation of the line from steam to electricity.

The Standard Light & Power company, Montreal, Que., announces that it will begin work immediately on an electric railway to Lachine, by way of the Upper Lachine road.

The plans of the electric railway which it is proposed to construct at Oshawa, Ont., have been accepted by the city council. The road will be built in three sections and will receive a cash bonus of $5,000.

A steampipe exploded in the electric power house at No. 302 Blue Island avenue, Chicago, recently, filling the place with steam and causing great excitement in the neighborhood. The steam was shut off until the pipe could be fixed.

The Southwestern Electric Light & Water Power company will erect a big light and power plant at Joplin, Mo., including repair and manufacturing shops, for a general electrical business. An electric railway to Galena, Kas., is also proposed.

It is said that Germany has more electric railways under construction than any other European country. There is not much opposition to the trolley there. France follows Germany in this particular, and Russia is waking up wonderfully upon the subject

The Youngstown, O., street railway was tied up July 26th. During the night some unknown person grounded the trolley wires in such a manner that the electricians of the company were unable to locate the trouble for some time. The company claims that the new men sent to Youngstown to operate the motors are experienced hands and that they are now in a position to run their cars if permitted to do so.

The Chicago Electric Transit company has taken out building permits for a one-story power house on Roscoe boulevard, to cost $150,000, and a two-story car barn at Elston and Warner avenues, to cost $35,000.

The management of the Grand Berlin Horse Tramway company of Berlin, Germany, has erected an accumulator station and will experimentally work a line on the accumulator system from Werftstrasse, Moabit, to Hansaplatz, Luzowplatz, and Potsdamerstrasse.

The official returns regarding the working of the electric railway at Marseilles, France, show that it is being greatly appreciated by the inhabitants. During the first two months of this year the number of passengers carried over the lines—which is about five miles long—amounted to 645,384, as against only 423,267 in the corresponding period of last year.

One of the most recent contracts received by the Westinghouse Electric & Manufacturing company was for the 1800 horse power generators and equipment for the new power plant of the Second Avenue passenger railway, Pittsburg, Pa. The value of the work approximates $25,000. Russell & Co., Massillon, O., have secured the contract for the compound condensing engines.

The lease of the Rochester, N. Y., and Charlotte electric railway by the Rochester Railway company for a term of 50 years has practically been agreed upon. The first named road is operated between Rochester and Charlotte. Many advantages will be gained by placing both roads under one management, as the cost of operation will be much decreased, and improved service will doubtless be had.

It has at length been decided at Paris to consider the question of mechanical traction, and particularly electrical traction. The municipal council has yielded to the arguments urged on all sides for the establishment of mechanical railways. It has been decided to send a delegation to study the various systems of traction in use in other countries. This is an important step, and it is thought that on the return of the delegates the municipal authorities will authorize the establishment of electrical railways in Paris.

## TELEGRAPH.

Alexander Siemens has submitted an offer to the Dominion of Canada for laying a cable under the Pacific Ocean from Victoria, British Columbia, to Sydney, New South Wales. He undertakes to complete the construction within three years. The offer is now being considered.

The Paris, Lyons & Mediterranean Railroad company has established "telegraph boards" at the principal stations, on which dispatches for passengers or for persons awaiting the arrival of passengers are posted. A traveler who misses a train can telegraph in the care of the station master to the person awaiting his arrival at his destination.

The Western Union Telegraph company's manager, R. B. Davis of Fort Madison, Ia., was ordered to produce certain telegrams sent and received by officials of the American Railway union during the strike. This, under the advice of counsel, he declined to do and was promptly sent to jail by the judge for contempt, the court claiming that the federal court overruled the Iowa state law.

The three Tiffin, O., street railways which are embraced in the Tiffin & Intersuburban Consolidated Railroad company passed into the hands of a receiver on August 2d. The assets are said to be $150,000 and the liabilities will likely exceed that figure. The appointment of a receiver was made by Judge Norris at the suit of the Cambria Iron company to secure a claim for $5,000.

It has been decided to abandon Hawaii as a port for the landing of the Canadian-Australian Pacific cable. Proposals are invited for seven different routes and upon three different plans, namely: Plan No. 1 invites bids for the construction of a cable to be the property of the government, but to be guaranteed by the construction company. Plan No. 2, for a cable to be run by a company undertaking the work under the basis of a subsidy, the proposal to stipulate the amount of the subsidy required and the number of years for which it will be operated. The third plan calls for the bid for the construction and operation of a cable for a stipulated guaranty of earnings to be made by the companies bidding. The constructing companies are asked in each case to bid for seven different routes under the three separate plans mentioned, the government to regulate the amount of tolls to be charged by an order in council.

The conflicting and scanty reports from Japan and Korea may be attributed to the fact that cable communication with Japan is interrupted; but whether this interruption is caused by the official closing of the telegraph offices or by the still more summary method of cutting the cables, cannot be ascertained. It is certain, however, that neither Chinese nor Japanese would have the slightest difficulty in destroying the cables, as from Shanghai to Nagasaki they run in water less than 50 fathoms deep for 200 miles from Shanghai; and the Nagasaki-Vladivostock cables, for nearly the same distance, lie in water under 100 fathoms deep. The cables of the Eastern Extension company, which at present are the only means of communication with China, could be picked up easily and without any very special appliances. The cable recently laid between Singapore and Hong Kong, touching at Labuan, lies for about 600 or 700 miles in water not exceeding 40 fathoms in depth. Communication with Australasia is altogether dependent on cables, which, in the Java Sea and the Straits of Malacca, run for about 1,000 miles in water nowhere deeper than 40 fathoms, and averaging about 25 fathoms, and which are therefore completely at the mercy of any craft which happens to have an anchor to drag across these lines. Cables to-

India could be easily cut, either in the Gulf of Suez or at the entrance to the Red Sea, where the shallow water (under 40 fathoms) leaves communication with India, Australasia and China, altogether in the power of any hostile vessel.

## MISCELLANEOUS.

A large boiler in the water station and electric power house at Perry, Ia., exploded last month, fatally injuring the manager and completely wrecking the building. The loss is estimated at about $15,000.

The plant and property of the Hyde Park, Ill., District Telegraph & Electric company, which is in the hands of a receiver, was sold on August 1st by an order entered for $5,500. Half of this amount was paid in cash and the balance is to be paid in notes payable in a year.

*The Universal Index to the World's Technical and Scientific Literature* is the title of a new publication in Leipzig, Germany. The index is printed in several languages and gives a list of the principal articles appearing in technical and scientific publications throughout the world.

The Electric Circuit of St. Louis, a club organized during February, 1893, has been experiencing a rapid growth. Considerable interest was manifested at the semi-annual election of officers, which took place last week. The following named officers were elected: President, Alexander R. Pike; vice-president, John H. Fenton; secretary, Otto W. Uthoff; treasurer, F. B. Briner.

By permission of the postal authorities the wires between St. Margaret's Bay and the general postoffice, London, were recently used for the purpose of conducting some experiments with Prof. Gray's telautograph. Special instruments were fixed at both ends, and the experiments were watched with interest. Messages were transmitted successfully over a distance of 83 miles.

A Cuba, N. Y., man has constructed an electrical farm wagon, using storage batteries and a motor, as in other electrical vehicles. It is suggested that on large farms electricity may in time play a prominent part by the use of windmills driving small dynamos automatically connected with storage cells. The current could be used for lighting and various power purposes, including the propelling of vehicles.

Arrangements for repaving a number of down-town streets in Chicago that have been torn up from time to time by electric light, gas and other companies, which are considered unfit for use by the department, have been completed. The following named electric corporations are in the agreement to do the work within the next two or three months: Chicago Telephone company, Chicago Edison company and the Sectional Electric Underground company. The streets to be repaved are: State, from Jackson to the river; Jackson, from Michigan avenue to the river; Madison, from Wabash avenue to the river; Monroe, from Michigan avenue to Market; Dearborn, from Jackson to the river. The total cost of the work is to be $42,000.

## TRADE NEWS.

The Partridge Carbon company, Sandusky, O., is sending out a photographic reproduction of a pen and ink drawing showing its works.

The Chicago office of the Electric Construction & Supply company, New York, manufacturer of the Ward arc lamp, has been moved from the Unity building to 271 Franklin street.

The Beacon Vacuum Pump & Electrical company, Boston, is quoting 16 candle power lamps in barrel lots, each barrel containing 200 lamps, at 25 cents, and 32 candle power lamps at 35 cents. In smaller quantities five cents per lamp extra is charged.

W. C. Groetzinger, general manager of the Chas. Munson Belting company, whose head offices are at 22 to 36 South Canal street, Chicago, is receiving the congratulations of his friends on the increased business which his company has done during the recent financial depression. The superior quality of the well-known Munson dynamo belt seems to be very well established, and consequently this year's business of the Munson company has been as good as that of any other year. Besides furnishing belting to a large number of electric plants, orders have been received from agricultural and saw-mill plants as well as manufacturing interests in general.

## BUSINESS.

The special shade holder receptable and special attachment plugs manufactured by the Bryant Electric company are meeting with favor.

The Berlin Iron Bridge company of East Berlin, Conn., is furnishing the iron roof for the new boiler and dynamo room for the Larchmont Electric company at Mamaroneck, N. Y.

J. H. Cooke, the Chicago and western representative of the Buckeye Electric company, says that the special coiled filament, 50 and 52 volt Buckeye lamp is meeting with much favor among alternating plants. The lamp is economical in the consumption of current and a brilliant illuminator from start to finish.

The Worthington Hydraulic Works, Brooklyn, N. Y., have decided to make large additions to their already extensive plant and have placed the contract for this work with the Berlin Iron Bridge company of East Berlin, Conn. The Berlin company is putting up a gas house roof for the New Jersey Gas & Construction company at South Amboy, N. J.

The National Conduit Manufacturing company, New York, has done a very considerable amount of underground work in this country and Canada during the last year. It has just closed a contract with the Boston Electric Light company for all the subway work for this year; it has also contracted with the Nebraska Telephone company for all the conduits for the Lincoln subway, which is to be built this year.

The Washington Electric company, 207 South Canal street, Chicago, has received quite a number of orders for its annunciators, which are rapidly finding favor among users. The company can furnish annunciators with any number of indicators, in antique oak, natural oak, ash, natural cherry or mahogany finished cases. It is the company's aim to produce the best work possible at a reasonable price, and the success with which it has met would indicate that this is appreciated.

The Electric Appliance company, Chicago, is meeting with success in the introduction of the Arnold magneto telephone, for which it is the general selling agent. The loud speaking and clear articulating qualities of the instrument recommend it to an intending purchaser, and the Electric Appliance company states that where the instruments have been sent out on a competitive test they have always been successful, and instruments sent out subject to satisfactory operation or on approval are always a sure sale.

The New York Edison Electrical Illuminating company has contracted with the Electric Storage Battery company of Philadelphia for a large storage battery installation. The installation will consist of 150 elements of chloride accumulators, type G, 41 plates, having a capacity of 8,000 ampere hours at 150 volts, at normal rates, or a total capacity of 1200 kilowatt hours. The installation will be furnished with the most modern and complete appliances for the control and operation of the battery, and everything possible will be done to make it a model and complete battery plant. The battery is to be installed immediately, to be ready for the heavy winter load.

George B. Grant, for some time a manufacturer of gears in Lexington, Mass., and Philadelphia, Pa., and the author of "A Treatise on Gears," has started a new gear shop at No. 80 Seneca street, Cleveland, O. It is fully equipped for making and cutting gears, and is fully stocked with ready-made list gears. Mr. Grant has recently patented a bevel gear cutter, which produces a perfectly shaped tooth the full width of the face. This machine is in practical operation, and he is prepared to give estimates for cutting gears by this new process. This new shop will give western customers better accommodation than they have ever had, and will be fully appreciated by those who are looking for first-class gears. It is in charge of William K. Bailey, who has been the superintendent of the Lexington shop for some years.

The Wallace Electric company, Chicago, reports business as improving in all its different departments. The railway department especially is kept busy filling orders for Wood's overhead devices, which the company controls. The new patent trolley wheel which it has just placed upon the market, is meeting with general approval. The standard red core Habirshaw wire still obtains the preference where the durability of an insulation is the most important feature. The Wallace company has also added a complete line of arc lamps to its general specialties, and is prepared to ship promptly arc lamps for almost every purpose. The line includes ornamental and plain lamps, alternating and direct current lamps, series lamps, twin lamps, focusing and search lamps, railway lamps and theatrical lamps.

In 1883 O. J. Garlock, whose occupation at that time was chief engineer for the firm of Bartle & Eames, invented a packing, and after many successful experiments applied for and was granted letters patent for the United States and Canada. The business was commenced in a small way without capital; but the demand for the packing made it necessary to secure facilities for properly conducting the business. The members of the firm constituting the Garlock Packing company at present are O. J. Garlock, E. Nichols and F. W. Griffith, as organized in 1887, since which time the business has developed with great rapidity. This company now manufactures its goods in Palmyra, N. Y., and Rome, Ga. Extensive offices and warerooms are located in New York, Philadelphia, Pittsburg, St. Louis, Omaha and Chicago. The company states that its business, notwithstanding the hard times, was nearly doubled in 1893 over the previous year.

The Chicago Cross-arm company, 932 Monadnock building, Chicago, is calling attention to the government tests of woods used for cross-arms by the United States Department of Agriculture, which shows long leaf yellow pine to be fully 40 per cent. stronger than white or northern pine. According to this official test white pine has a tensile strength of 10,700 pounds to the square inch, a cross-breaking modulus of 6,620 pounds to the square inch and a breaking load of 3,820 pounds, while the long leaf yellow pine has a tensile strength of 21,300 pounds to the square inch, a cross-breaking modulus of 13,300 pounds to the square inch and a breaking load of 5,060 pounds. The Chicago Cross-arm company is a manufacturer and dealer in long leaf yellow pine cross-arms, locust and oak pin and pays particular attention to the material for electric lines. All line construction, however, is attended to by this company.

The Ries Electric Specialty company, Baltimore, Md., has made application for the appointment of a receiver to take charge of and close up the business of that company. Elias E. Ries, the president of the company, states that the corporation is unable to successfully prosecute its business, owing chiefly to internal dissentions among some of its stockholders, and that the assets of the company are thereby in danger of being wasted to the prejudice of the creditors. Hence the petition for a receiver, who has been appointed, with the consent of all concerned, for the purpose of dissolving the corporation and making an equitable distribution of the assets among the creditors and shareholders. The company was incorporated June 16, 1890, and has been engaged in the manufacture and sale of several well-known specialties, including the Ries regulating sockets for incandescent lamps. The company owns a number of valuable patents and a well equipped manufacturing plants, occupying the entire building at No. 7 South Gay street. It is the intention of Mr. Ries to shortly reorganize the company under more favorable auspices and to take up in addition to the inventions now controlled by it the manufacture of some additional specialties for which there is a large demand.

The shops of the Ball Engine company, Erie, Pa., present a scene of activity in spite of the unfavorable condition of trade generally and are running full time. There have been shipped from the works lately engines for the following concerns: Edison Electric Light & Power company, Erie, Pa., a 350 horse power vertical compound and a 300 horse power cross-compound engine; Eureka Light company, Eureka, Cal., a 300 horse power engine; Industrial Home of the Blind, Chicago, an 80 horse power engine; J. H. Houghton, Boston, Mass., a 50 horse power engine; Minneapolis General Electric company, Minneapolis, Minn., a 35 horse power engine; Bronx Gas & Electric Light company, Van Nest, N. Y., two 250 horse power tandem compound engines; Hotel Newcombe, Quincy, Ill., a 60 horse power engine; Gen. A. S. Bushnell Building, Springfield, O., a 60 horse power engine; Lexington Electric Light company, Lexington, N. C., a 50 horse power engine; Greenwich Gas & Electric Light company, Greenwich, Conn., a 150 horse power and a 125 horse power engine; Kennard House company, Cleveland, O., a 50 horse power engine; city of Griffin, Ga., a 135 horse power engine; Howe Pump & Engine company, Ladd, Ill., a 50 horse power engine; Sykes & Wagner, Minneapolis, Minn., an 80 horse power engine; F. F. Vater & Co., Minneapolis, Minn., a 35 horse power engine; Risdon Iron Works, San Francisco, Cal., a 150 horse power engine and, the Electric Supply & Engineering company, Detroit, Mich., a 70 horse power engine.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued August 7, 1894.*

523,986. Process of Electric Metal Working. Hermann Lemp, Lynn, Mass., and Walter S. Moody, Chelsea, Mass. Application filed October 20, 1890.

The invention consists in special methods of preventing the localization of the heating currents or effects where the currents are introduced or passed through the material at an angle to one another.

523,987. Electric Welding Machine. Hermann Lemp, Lynn, Mass. Application filed January 19, 1891.

This invention consists in constructing electric welding machines so that they shall be in their main features essentially all alike, and providing accessory devices of varied character which may be attached to the machine as occasion may demand in connection with the different kinds of work to be done. Such attachments or accessories are so made that no skill is required in effecting a change for variety of work beyond that of the ordinary machinist.

523,995. Electrical Motor. Henry B. Porter, New York, N. Y. Application filed December 5, 1893.

The construction of the motor, as shown in the accompanying illustration, which also shows a cross section of the driving shaft with a device for alternately changing the current from one motor to another, has been designed with reference having been paid to means for automatically changing the current from one motor to the other when two are employed for operating a driving shaft, in order that each may alternately act to draw the reciprocating connecting rods back and forth and rotate the connecting shaft. This device consists of a sleeve *i* located upon a shaft in a manner to rotate therewith, and also slide horizontally thereon, the surface of which is divided into three sections, the central section *i*² being of non-conducting material and the end sections being formed of conducting and non-conducting material, as shown at *i*¹ and *i*³, each forming half the circumference of the sleeve. The circuit from the battery *y* is alternately changed from one motor to the other, for the purpose mentioned previously, by means of two brushes *k k*, forming one end of the circuit wires, which engage with the sleeve *i* and alternately make and break the circuit as the conducting or non-conducting surface of the sleeve is in contact with the same during the revolution of the shaft. The operation of the shaft may be stopped or reversed by shifting the sleeve on the shaft to bring the proper surface into contact with the brushes by means of a pivoted rod which engages therewith.

523,998. Dynamo-electric Machine. Gustav Rennerfelt, Lynn, Mass. Application filed March 6, 1894.

The object of the invention, which belongs to the class of unipolar machines, is to increase the potential of the current generated by that class of machines, and to render such machines more durable in construction.

524,003. Electric Arc Lamp. George G. Stout, Parkersburg, W. Va. Application filed June 16, 1894.

The invention has for its object to provide an electric arc lamp with means for excluding the air and drafts from the carbons to that extent which will enable a more perfect and steady light to be obtained with an increased volume as well as economy in the use of carbons.

524,009. Telephone Annunciator and Call Bell. Frederick G. Warrell, Philadelphia, Pa. Application filed June 25, 1891.

The inventor designs to provide a combined system of telephone and call bell annunciators for hotel, house and other such like purposes of simple and inexpensive construction, so that the call indicated by the annunciator may be connected by telephone communication by the mere adjustment of the proper switch at the switchboard, and in which each of the respective terminals may be connected with the annunciator and central telephone on independent circuits

524,011. Electric Motor. Frederic C. Whitmore, Lynn, Mass. Application filed May 5, 1893.

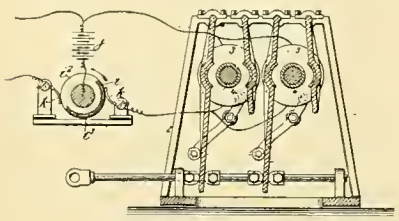
The invention relates to dynamo electric machinery, its object being to provide a simple and economically constructed motor, comprising but few parts, readily assembled and occupying but little space when completed and in running order. Such a motor is especially designed for boats and launches, although, of course, it might be equally well applied in any other case where motive power is required.

524,014. Trolley Wire Support. Levi Yakel, Allegheny, Pa. Application filed April 15, 1893.

The inventor aims to produce an insulator which shall be not only efficient, but easily adaptable to all the requirements of an overhead conductor.

524,017. Trolley for Electric Cars. George C. Bourdereaux, Peoria, Ill. Application filed March 12, 1894.

A durable and self-lubricating trolley for electric cars is described.



NO. 523,995.

524,020. Dynamo-electric Machine. Rudolf Eickemeyer, Yonkers, N. Y. Application filed October 7, 1891.

This application is intended to specially embrace or include certain widely applicable improvements heretofore invented by the patentee when embodied in such dynamo-electric machines as depend for their magnetic field upon electro-magnets, appropriate portions of which afford suitable cheek pieces.

524,025. Conduit Electric Railway. Rudolph M. Hunter, Philadelphia, Pa. Application filed September 12, 1891.

The invention comprehends certain improvements in car construction with especial reference to the running gear and motor connections, and also to the collector for conveying current from the conductors along the railway to the motor circuit on the car. This patent is an addition to an application filed by the inventor November 30, 1886.

524,038. Railway Signaling Device. William Daves, Jersey City, N. J. Application filed August 3, 1892.

In a railway electric signaling system adapted to be actuated by a moving engine or train, the combination with two armature levers and their contact for closing the signal circuit, of means operated by one of the armatures in closing its circuit to move the circuit-closing contact out of the path of the other armature lever is patented.

524,044. Electric Pump. Frank W. Merritt and Arthur R. Roe, Duluth, Minn. Application filed November 6, 1893.

The inventors claim the combination of a pump cylinder provided with a reciprocating piston, a bar armature attached directly to the piston rod and provided in the direction of its length with a number of coils, a commutator carried by the armature and consisting of a series of insulated contact plates arranged parallel with the axis of the armature and connected with corresponding coils of it, a series of field magnets of alternately opposite polarity arranged parallel with the movement of the armature, and a switch arranged to reverse the current through the field or armature coils at the end of each stroke of the armature.

524,062. Electric Heater. Jesse F. Kester, La Grange, Ill. Application filed April 29, 1893.

The object of the invention is to produce an inexpensive, efficient and durable heater of the class which consists essentially of coils or some other resistance medium arranged in a bed of insulating material and through which an electric current is passed. The invention is also applicable to rheostats.

524,066. Waterproof Insulated Electric Conductor. Duncan Macfarlan, Philadelphia, Pa. Application filed May 17, 1894.

The invenor describes a water and fireproof insulated electric conductor having a thread or cord of fireproof material saturated with a liquid insulating substance wound around it and a waterproof sheet or strip surrounding the conductor.

524,098. Annunciator. Philipp Weber, Nuremberg, Germany. Application filed January 16, 1894.

The principal object of the invention is to provide a new and improved electric annunciator in which the wiring shall be very simple

524,100. Supporting Insulator for Electric Wires. Lauren S. Beardsley, Naugatuck, Conn. Application filed June 11, 1894.

The invention is a holder for insulators consisting of a pin provided with screw threads designed to engage the screw threads in the interior of a glass insulator, the pin having projecting therefrom a bolt, a bolster for the bolt and means for securing the bolt in position.

524,109. Rosette for Electric Light Wires. Charles N. Hammond, Boston, Mass. Application filed December 7, 1893.

The invention has for its object to provide an improved rosette for electric wires which shall be adapted to receive a suitable fuse or fuses which shall be simple, durable and of high efficiency and in which the number of parts employed shall be reduced to a minimum.

524,116. Electric Arc Lamp. William S. Pendleton, New York, N. Y. Application filed March 6, 1894.

An electric arc lamp is described, the feeding mechanism of which may be understood by reference to the accompanying diagram. *E* is a movable carbon carriage, controlled by a cord or chain which is actuated by a wheel, neither of which is shown in the illustration, which is only intended to demonstrate ideas in the circuit-connections of the lamp.

524,117. Motor Suspension for Railway Work. Edwin W. Rice, Jr., Lynn, Mass. Application filed August 15, 1889.

It is the object of the invention to secure strength, rigidity and simplicity of construction together with an adaptation of the mechanism to jars and vibrations of the vehicle or its truck and an unchanged or fixed relation of the driving motor and intermediate gear to the car axle.

524,118. Printing Telegraph Instrument. James H. Rogers, Bladensburg, Md. Application filed December 12, 1893.

A paper carriage which has a movement very much like that of the paper carriage of an ordinary typewriter is employed and provided with an intermittent feed for advancing the paper a distance equal to that between one line and the next in intervals between the printing of successive lines—all of the movements of the carriage being automatic and controlled through the agency of suitable mechanism and electrical connections, from the transmitting end of the line. The movement of the carriage which takes place while a line is being printed is occasioned by a motor with which the carriage is engaged through the intermediary of a clutch, which for this purpose is controlled by an electro-magnet included in a local circuit closed through the agency of a polar relay, one of the windings of which is included in the printing circuit of the receiver. The opposite winding of the polar relay is included in a second circuit, upon the closing of which the armature of the polar relay is actuated to break the clutch circuit, thus releasing the clutch from the motor, and permitting the carriage to move back to its original position. The closing of the return circuit is occasioned by the carriage, which at the completion of its advance movement momentarily closes the normally open contacts in the circuit. The printing is effected by printing levers, operated by electro-magnets included in the printing circuit and controlled by devices previously patented by the inventor.

524,119. Dynamo-electric Machine. William B. Sayers, Glasgow, Scotland. Application filed January 6, 1894.

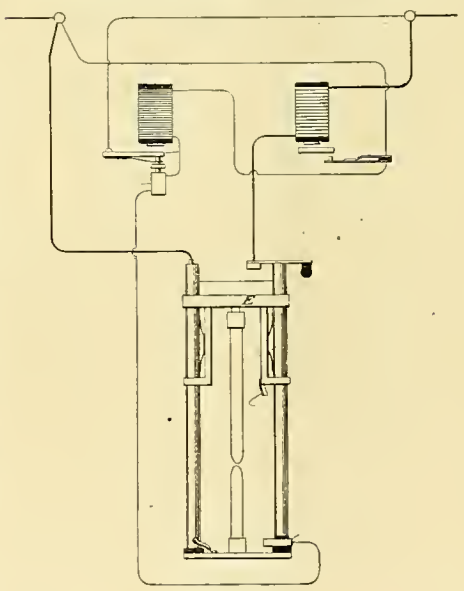
This patent is an improvement upon a former one by the same inventor, wherein such a machine as he previously described may be run either as a generator or a motor, without the necessity of providing it for this purpose with two commutators as described in the former invention.

524,120. Electric Hand Appliance for Massage. Andrew J. Speare, Thayer, Mo. Application filed April 16, 1894.

Means are provided to produce a device that provides for closing a circuit through the hands of an operator or physician when the hands are placed in contact with the human body.

524,136. Regulator for Dynamo-electric Machines. Thomas A. Edison, Menlo Park, N. J. Application filed November 11, 1881.

The object of the invention is to produce a simple and reliable means for automatically varying the resistance placed in the field circuit of a dynamo-electric machine so as to regulate the supply of current in a system of electric lighting supplied from such a machine. This is accomplished by means of an electro-magnet placed in the main or consumption circuit from the generator, which magnet, as it is more or less energized by the increase or diminution of current consequent on the addition or removal of lamps, actuates an armature lever by means of which more or less resistance is thrown into the field circuit, the latter being a derived circuit from the main line. Appropriate arrangements for accomplishing this are shown in the drawing, which represents a dynamo-electric generator and the circuits connected therewith.



NO. 524,116.

524,156. Thermo-electric Volatilizing Obtunder. Otto B. Bachman, Minneapolis, Minn. Application filed April 6, 1893.

The combination in an obtunder of a receiving chamber, means for supplying the obtunding medium under pressure to the chamber, an electrical heater arranged within the chamber, and an obtundent chamber connected with the receiving chamber, a discharge nozzle leading from the obtundent chamber and a valve arranged between the parts, is described.

524,165. Circuit Breaker for Electro-therapeutic Apparatus. Louis W. Downes, Providence, R. I. Application filed January 21, 1893.

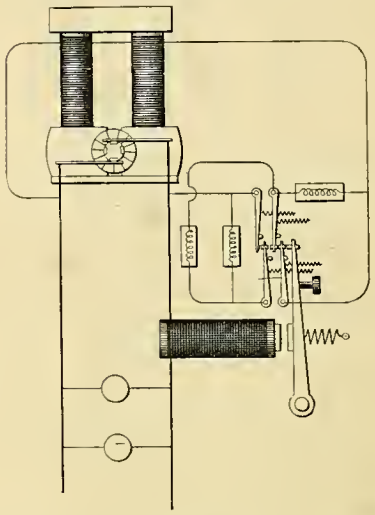
This invention relates to apparatus for varying the periodicity of pulsations of an electric current such as is employed in an inductive coil for medical or other purposes.

524,172. Variable Resistance Medium for Telephones. William W. Jacques, Newton, Mass. Application filed May 14, 1894.

The invention consists in an electric and microphonic boron and also in the process by which the electric and microphonic boron is produced. The process consists in reducing a salt of boron by heating it with sodium or potassium and again heating the product to a white heat in the absence of air.

524,173. Variable Resistance Medium for Telephones. William W. Jacques, Newton, Mass. Application filed May 14, 1894.

The invention consists in an electric and microphonic silicon and in the process by which it is produced. The process consists in reducing a salt of silicon by heating it with sodium or potassium and again heating the product to a white heat in the absence of air. The inventor mixes fluorosilicate of potassium with metallic sodium or potassium in proper portions to reduce the fluorosilicate of potassium. The mixture is then heated to redness in a closed iron retort. After the reaction has taken place the product is treated first with cold and then with hot water and filtered. The residue, consisting of amorphous silicon, is then heated to a reddish white heat in a closed vessel, from which the air is excluded. The product thus obtained is a granular electric and microphonic silicon suitable to be used as a variable resistance medium between electrodes in battery telephones of the Hunning or granular type.



NO. 524,136.

524,188. Electric Transformer. James J. Wood, Fort Wayne, Ind. Application filed March 19, 1894.

This invention relates principally to the construction of the inclosing case for transformers, its objects being to render the incased transformer more compact, to provide improved ventilation for facilitating the cooling of the transformer and to provide improved and more convenient means for facilitating the hanging or attachment of the transformer to buildings or to cross-arms on poles.

524,202. Electric Signal for Steamboats. Robert H. Gruschow, Chicago, Ill. Application filed January 30, 1894.

The invention relates to devices for electric signals on steamboats, in which a series of signals is operated by means of electric currents passed through coils and armatures; and the object of the invention is to construct an electric signal which shall be reliable and unfailing in its work.

524,229. Primary Battery. William Walker, Jr., Birmingham, Frank R. Wilkins, Handsworth, and Jabez Lones, Smithwick, England. Application filed February 27, 1894.

The invention has reference to single liquid primary voltaic batteries and has for its object to prevent wholly or in great part polarization in the batteries. In constructing a single liquid battery according to the invention amalgamated zinc is employed as the positive element and carbon as the negative element, the electrolyte or exciting liquid being preferably a strong solution of caustic soda or caustic potash.

524,232. Insulating Trolley Wire Support. Frank M. Zimmerman, Detroit, Mich. Application filed November 2, 1893.

It is the object of the invention to produce an insulating support that, while being a perfect insulator, will support the electric conducting wire very firmly against the strain placed upon it by the running of a trolley under or over it, and it also supports the wire by means such that the trolley has perfect freedom of movement along the wire in passing the support.

524,239. Submarine Signaling. Lucien I. Blake, Lawrence, Kan. Application filed December 22, 1893.

The invention is carried out in the following manner: An insulated cable is laid from the shore to a point near a lightship, where its core is electrically connected with the anchor of the ship. The anchor chain is placed in metallic connection with the sheathing of the vessel at the hawse pipe through which it passes. Between the sheating of the ship and a submerged plate held at a short distance from the ship's side a metallic circuit is established through a wire, to which is connected a telephonic transmitter and a receiver of very low resistance. Similar instruments are connected with the shore end of the insulated cable, and batteries provided for the transmitters.

524,282. Electric Railway Pole Ratchet. Thomas J. McTighe, New York, N. Y. Application filed January 23, 1893.

The object of the inventor is to produce a ratchet which can be attached directly to a metallic pole while being electrically insulated therefrom and consists in the combination, with a ratchet drum, of a carrying yoke therefor, and a cover box clamped or adapted to be clamped to the pole, the yoke and cover box being insulated from each other.

524,283. Trolley Wire Circuit Breaker. Thomas J. McTighe and Sumner W. Childs, New York, N. Y. Application filed January 23, 1893.

The aim of the inventor has been to construct a circuit breaker which while having the necessary insulating quality has its connecting parts in duplicate, each also bracing and stiffening the whole, and each insulated from the other, so that should a short-circuit or burn-out occur, it will be confined to one of these, and the other will keep the trolley line intact.

524,291. Primary Voltaic Battery. William Walker, Jr., Birmingham, and Frank R. Wilkins, Handsworth, England. Application filed June 4, 1894.

A single liquid primary voltaic battery consisting of a porous cell containg the exciting liquid in which the zinc or positive element of the battery is suspended, the other or negative element carbon in the form of powder and coarse grains, being retained in position around the outside of the porous cell by means of a wire gauze casing, is described.

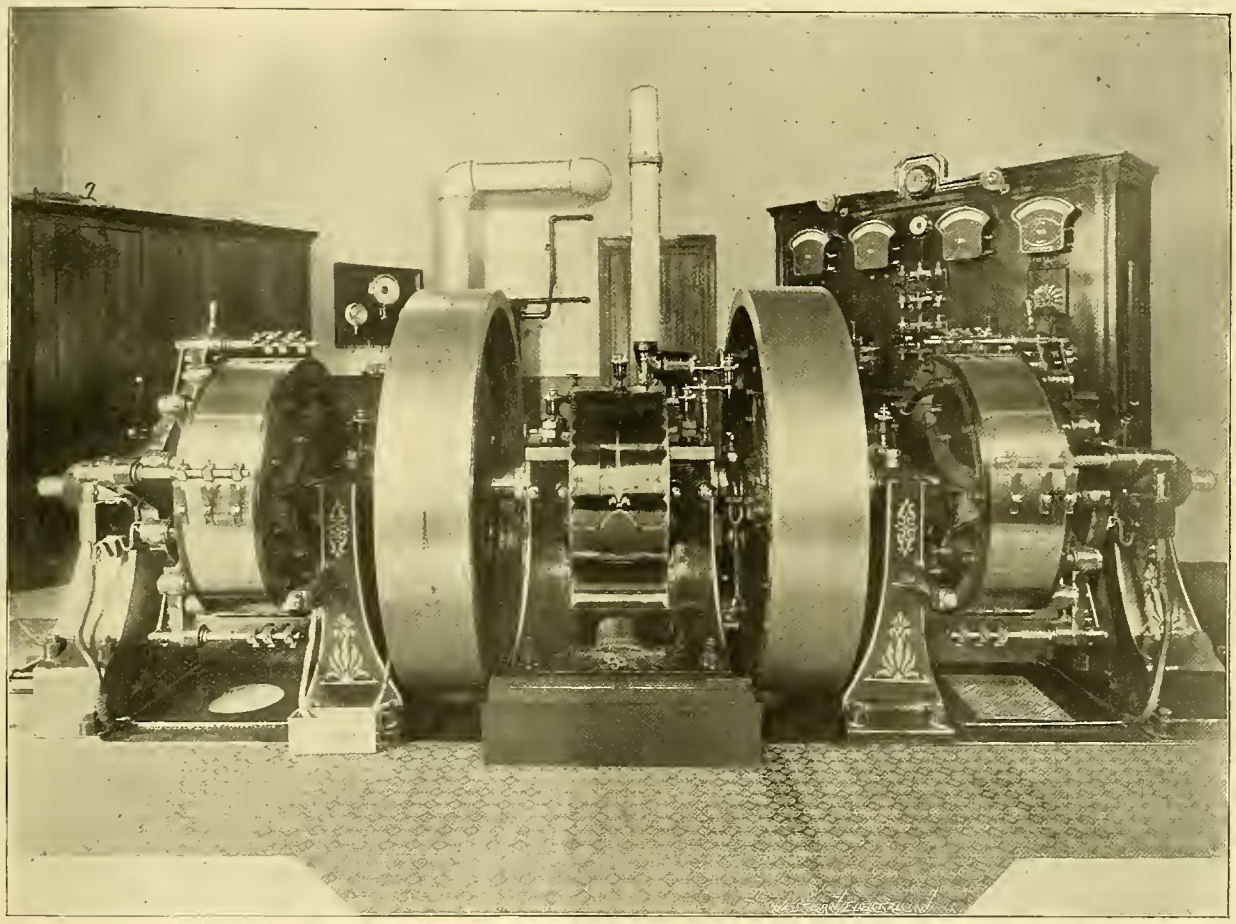
# Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, AUGUST 25, 1894. No. 8


## An Attractive Isolated Plant.

The use of directly coupled engines and dynamos for isolated electric lighting plants is extending so rapidly that individual examples have, as a rule, ceased to possess much of interest or value for those engaged in electrical pursuits. Nevertheless the plant illustrated by the accompanying picture is worthy of attention owing to its attractiveness, compact design and the evident care bestowed upon the whole installation. It has been set up in Ashbourne, Pa., one of the numerous suburban towns clustering about Philadelphia, and is the private plant of John B. Stetson. The engine is a New York Safety, rated at 100 horse power, with two fly-wheels. The main shaft is extended, and on either side is keyed to the armature shaft of a Siemens & Halske 110 volt direct



AN ATTRACTIVE ISOLATED PLANT.

current multipolar dynamo of 32 kilowatts capacity. The combination is operated at 270 revolutions per minute and is capable of supplying current to about 1,000 incandescent lamps of 16 candle power each. As will be seen, more than usual attention has been paid to the decoration of the machines, and a pleasing effect is thus obtained. The switchboard is equipped with Weston instruments, and the whole plant bears evidence of careful construction.

## Private Telephone Equipment.

One of the first private telephone installations to be erected in Chicago since the expiration of the fundamental Bell patent is that of the Whitman & Barnes Manufacturing company, whose power transmission plant at West Pullman was recently described in this journal. Ten Stromberg telephones have been placed in various parts of the large establishment, connected on the "mutual exchange" principle. Each telephone is provided with a switch having a contact and connection for every other instrument. Thus every user can put his telephone in circuit with any other without the intervention of a central exchange or an operator. This method involves the use of a large quantity of wire, but it is convenient and effectual, and the interest on the wire investment does not equal the wages of an attendant. The plant was installed by Gustave Monrath.

## Mr. Bean's Statement.

In relation to the trouble over the electric railway at Benton Harbor, Mich., which brought about the shooting of Alderman Shriver, as noted in the WESTERN ELECTRICIAN of last week, W. Worth Bean, president of the railway company, sends the following personal statement:

The street railway company constructed in November, 1892, two squares of tracks on Main and Sixth streets, running to Territorial street, under the terms and provisions of an ordinance passed, accepted and approved August 17, 1892, the same continuing on Territorial street and other streets to the east city limits. On June 7, 1893, the city council agreed with the railway company to repeal that portion of the ordinance on Territorial street and change the same to Main street, with the understanding that the property owners were to pay the railway company one dollar per foot to develop the property on Main street. Last June the financial depression caused trouble and the property owners could not raise the money. In May, 1894, the ordinance expired by limitation, this company claiming no further rights under it. On August 6, 1894, the property owners and this company came to an agreement. That night the council passed a resolution repealing the ordinance of June 7th, and requesting the company to remove the tracks at once.

I met the council committee on Thursday, August 9th, and agreed to change the grade of two thousand feet of track, and move all poles to the curb line free of expense to the city. I also agreed to see that my track was planked with good three-inch plank. The original grade was established by the city engineer and tracks were laid according to his stakes. Two members of the committee said I should pave with cedar blocks. I declined to do it, as the planking was considerably better than the cedar blocks with sap, just the kind they are using for paving. Without authority of law or even a resolution from the city council, two aldermen of the street committee, with one of the paving contractors, three policemen, four wagons and a gang of thirty laborers, at the unseasonable hour of four o'clock, and on Sunday morning, proceeded to destroy my company's tracks. I appealed to the deputy sheriff after tweve o'clock Saturday night, and at his request and knowledge furnished him a posse of five men and myself with four guns. I ran a car to the scene of action, and the track destroyers, upon its approach, began to throw blocks and planks on the track and proceed with picks to dig up the track. During this proceeding and while the sheriff was trying to make them desist my gun was accidentally discharged from the front platform of the car, the contents striking the gate of the car and going into the ground, with the exception of two No. 2 shot, which struck one of the aldermen, who was some distance away. One shot lodged in the thumb, just under the skin, and the other one lodged in the front part of the leg, just above the knee. I assured them at the time that it was an accidental discharge of the gun. Not until after the accidental discharge of the gun was heard did the sheriff have possession of the field. They gave me no time to appeal to the courts for relief, and I knew nothing of it until late Saturday night.

At the time of the trouble and arrest I was in full possession of the property, and after giving bonds and turning the property over to the sheriff for protection, I returned to my office in St. Joseph. After all of us had left the property and the sheriff had taken charge of it for protection, he allowed the riotous work to begin again, and they succeeded in destroying the track, to the utter disgust of a large number of taxpayers and citizens, who so badly needed the road to Morton's Hill. A petition had been circulated among the property owners and citizens of the East Side, known as Morton's Hill, and subscriptions had been taken for the further extension of this track.

The water power of the River Valserine has already been utilized for driving the dynamos of the oldest electric light station in France, that of Bellegarde-sur-Valserine, Ain, but only 120 horse power is employed there. J. Guillemet has now drawn up a project whereby about 7,500 horse power would be made available.

## Novel Electrical Device for Racetracks.

Richard E. Sherman of Chicago has devised an electric railway system for race tracks to be utilized by patrol judges for following horses in a race, an idea of which may be gained by reference to the accompanying illustrations. Patents have been applied for on the several features of the apparatus, and the photographs which are reproduced were taken of the model. Numerous plans have been proposed to enable judges to be constantly near the horses upon a race track, but as yet none have met with any particular amount of success, partially owing to the high speed that must be attained to enable the moving car to run with absolute safety at the rate of a mile in two minutes around a continual curve. The construction proposed by Mr. Sherman is a suspended car and separate wires for support

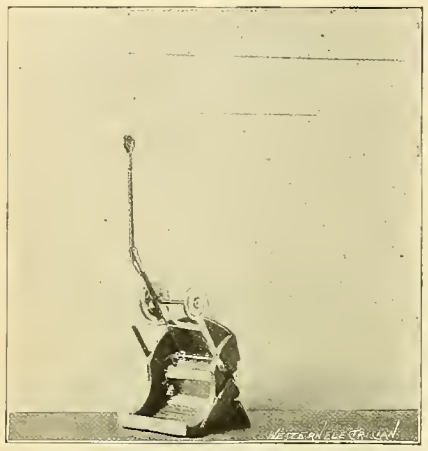


FIG. 2. NOVEL ELECTRICAL DEVICE FOR RACETRACKS.

and for carrying the current to energize the motor. It is intended to suspend the car, as shown in Fig. 1, upon wire three-fourths of an inch in diameter, No. 16 copper wire being used to carry the current at 110 volts, and the supporting wire being suspended from wooden poles at the side of the track. The car is made of wood and of sufficient size to accommodate two persons. The motor, as seen in Fig. 2, is placed under the seat and is controlled by a braking device operated by the foot. The armature carries upon its shaft a wheel, belted to another wheel mounted upon the shaft, which also carries the wheel by which the car is suspended. Swaying of the car while traveling at a high rate of speed is lessened to a great extent by the trolley arm, which is provided with a stiff spring. It is the idea of the inventor to equip racetracks with this apparatus and one is now in process of construction at the

FIG. 1. NOVEL ELECTRICAL DEVICE FOR RACETRACKS.

Hawthorne track, near Chicago. Current can in most cases be easily secured from neighboring circuits or a small dynamo may be installed with the motor equipment. The details of the scheme have been carefully worked out and it is intended to soon give the system a practical test. Should it prove a thorough success the patrol judges will be able to watch each horse all the way around the track, and "jockeying" can be at once detected. The car will, of course, run a little in the rear of the horses. The model from which the illustrations were taken was made by A. E. Yeoman, Chicago.

It is reported that Siemens & Halske, of Berlin, intend to establish an electrical plant in the Witwatersrand mining district of South Africa, to supply electrical energy for pumping, boring and other purposes.

## Electric Illuminating Plant of the Herzberger Insane Asylum, Lichtenberg, Germany.

On July 1, 1893, the newly built city insane asylum at Lichtenberg, Germany, was opened to the public. This institution, one of the most notable of its kind, lies northeast of the village of Lichtenberg and north of the Friederichsberg colony near Berlin. The size of the plant may be judged when it is stated that the institution covers an area of about 36 acres, upon which there are not less than 25 buildings. The establishment is capable of accommodating from 1,000 to 1,100 patients, the number of the officers and employes being in the neighborhood of 250. The buildings include six large hospitals, two detention houses and a number of farm houses, besides residences for the director and officers. Adjacent to the limits of the institution proper there are various other buildings, as well as a courtyard of considerable extent, and also the boiler house. Branching out from the boiler house are large subways specially designed for the purpose of conveying the hot water pipes, steam pipes and electric conductors to all of the numerous buildings.

Gas illumination has been excluded entirely—in fact, was not considered—in the construction of this plant, partly for reasons of economy, but more particularly in this case on account of its danger, heat generating properties, etc. The experience gained in the use of electricity at the city hospital of Urban gave every evidence of the fact that an electric lighting plant, properly constructed and efficiently operated, would be far more economical than a gas plant of the same dimensions and without the objections of the latter. The satisfactory results obtained from the electric lighting plant at Urban are due to the fine condition and arrangement of its components. The large number of lamps, the economy of the steam apparatus and dynamos, the determination of proper proportions relating to the capacity of the dynamos and accumulators, and the maintenance of the central heating plant, which at the same time serves the engines, may be mentioned as factors of success. As the general conditions at the Herzberger institution were very similar and quite as favorable, the electric light was decided upon, and the city authorities authorized the firm of Naglo Brothers, the constructors of the Urban plant, to proceed at once with the execution of that at Herzberger also. The illuminating plant in operation in the spring of 1893 consisted of two arc lamps of 15 amperes each, six arc lamps of 9 amperes each, 10 arc lamps of 6 amperes each, 2,160 16 candle power and 78 32 candle power incandescent lamps. Of these lamps the 32 candle power and a number of the arc lamps serve to illuminate the grounds, while the remainder are distributed about the interiors of the several buildings. With reference to the disposition of the plant, the requirements demanded that an emergency plant be installed, which, in case of the failure of the principal source of energy, should be capable of filling all requirements for illumination without interruption. This problem was solved through the application of the three-wire system. In the case of failure of one-half of this system, whether through the accidental breaking down of the motive power, or through any cause attributable to the failure of the principal plant, or to a break in the system of wires, the current would still be maintained at the same pressure, the center or neutral wire being of large enough capacity to carry all of the current and to act as outside conductor. In order to insure the reliable operation of the center wire at all times, without danger of interruption, fuses have been studiously omitted; instead of which, however, all branches from main leads, and all wires to single lamps and groups of lamps, have double-pole fuses, so that the operation of the center wire is assured beyond all question, and injury to it practically impossible. To meet the requirements of the emergency plant, the three-wire system is carried into all rooms containing more than one lamp, so that if one-half of the system should break down, the operation of the other half is not impaired. Fig. 1 shows the ground plan of the engine room and boiler house. The greater portion of this building is occupied by the boilers. This is explained from the fact that the boilers not only serve to feed the engines, but to furnish steam for heating the buildings. The boiler room contains 10 Heine boilers. To the right, adjoining the boiler room, is a shop used as a workshop, also a room for the superintendent, and a room in which is stored the valves and apparatus of the steam system. To the left and adjoining the boiler room is the accumulator room and engine room, separated by the acid room. Fig. 2 presents an excellent view of the engine room, which contains three vertical compound condensing engines. The engines were built by the Berliner Maschinenfabrik and are of 100 horse power capacity each. Their high pressure cylinders have a diameter of 350 millimeters, and the low pressure cylinders 600 millimeters. The guaranteed steam consumption for one indicated horse power is 7.75 kilogrammes at a pressure of seven atmospheres. The engines are provided with jet condensers, but as water is not to be had in sufficient quantity for injection, it was necessary to add a surface condenser, which was placed by the side of the boiler house. The necessary pump in connection therewith is operated by an electric motor built by the firm of Naglo Brothers. Belted to each engine is a continuous current dynamo made by the firm mentioned. These machines are of the drum armature four pole type. The body of the armature is carried on a very strong hub, the iron disks composing it being pressed together by strong bronzed rings held in position by bolts. The windings consist of single bars of copper connected in a peculiar manner. At a speed of 450 revolutions per minute the machines deliver 500 amperes at 120 volts pressure. When necessary, for the purpose of charging the accumulators, the voltage may be raised to 180. The effective work of each of these dynamos at full load is about 90 electrical horse power. Any two of these machines are sufficient to supply the maximum demand of the plant, even should it be increased to an additional 15 per cent. It is therefore not necessary to draw upon the storage batteries for current while the machinery is in operation.

The accumulator battery consists of 130 Tudor cells made by the Hagen company. The minimum capacity of this battery is 830 ampere hours at a discharge of 248 and the maximum capacity 1,190 ampere hours at 142 amperes or under. The battery is capable of maintaining about 1,000 incandescent lamps 3½ hours or 560 lamps 8⅓ hours. Each one of the three dynamos is self exciting or may be excited by the battery as occasion requires. For this purpose, close to the regulator is placed a switching device provided with two contacts. When switched on to one the exciting is accom-

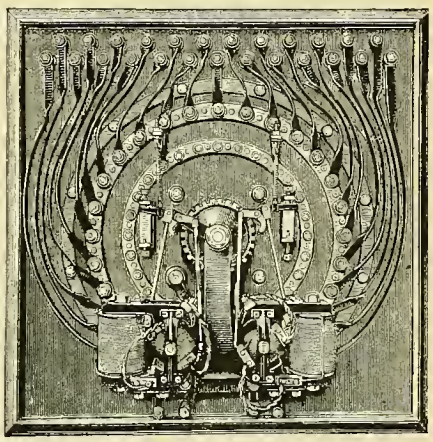


FIG. 4. ELECTRIC ILLUMINATING PLANT OF THE HERZBERGER INSANE ASYLUM, LICHTENBERG, GERMANY.

plished through the batteries, and when on the other through the dynamos themselves. The distributing bars seen at the top in Fig. 3, which shows the wiring system, are connected up to three automatic compensating switches.

By this means not only are the two outside conductors provided with switches, but the center wire also, and in consequence of this method the number of regulating devices is materially lessened. Each half of the three-wire system is permanently connected to one of the outside dynamos, while the center machines can be switched to one or the other half of the system as may be found necessary. As the division of potential, as may be seen, is not accomplished through the accumulators, but by the dynamos, it is evident that the plant does not depend on the battery for its operation. Near the battery switches are placed switches with two contacts. When the lever is turned on one contact, the current from the machines passes to the cell-charging switch; when on the other, into the leads for the several circuits. The pressure in the distributing bars and feeders is entirely controlled by a pair of voltmeters in circuit with automatic switches. The dynamos and accumulators are also provided with the necessary complement of instruments. The entire set of measuring, regulating and switching apparatus is remarkable for its compactness, perfection of construction and general excellence. The compensating switches, Fig. 4, are particularly interesting. In principle of construction and operation they very much resemble the automatic devices of the Hagen Accumulator company.

To set in action the toothed wheel which is connected to the switch lever, there are two pawls, one of which acts when the tension is too great, the other when it is too low. These pawls are operated by an electro-magnetic device something on the principle of the electric motor, with the difference that they are not designed for rotary but for oscillatory motion. The device consists of an iron armature spool moving in a strong magnetic field. The battery cell switches

are controlled by contact voltmeters and quicksilver contact relays. The operation of this arrangement is most reliable and satisfactory. Extending from the engine room and supported on insulators in the conduits, which are connected with the boiler house, are copper bar feeders branching out to three feeding points. From these the lamps distributed about the grounds receive their current. The conductors for the residences of the officers and farm houses, as well as to the courtyard and the grounds, receive their current through underground cables. The illumination of the halls and staircases in the single buildings is separate from the sick wards, and can be altogether switched out. The system of wiring has been done in the most careful manner, none but porcelain insulators having been used in its construction. The conductors leading to upper stories are placed in grooves of masonry, which on removal of the ceiling are directly accessible. The switches are accessible only to such persons as are authorized to look after them.

All the requirements necessary to proper conditions and the welfare of the patients confined in the various wards have been taken into careful consideration. It may also be mentioned that the electric illuminating plant contributes to the general welfare of the patients, inasmuch as it is used to light up a small stage used for their entertainment, and also to supply current for a projecting lantern. The incandescent lamps used for exterior lighting are placed partly on wall arms or brackets and on iron candelabra. These candelabra contain in their sockets double-pole fuses, which on removal of a covering plate are easily accessible. The underground conduits which serve to conduct the heat and which contain the conducting system are also lit by 60 lamps. These lamps, placed at long intervals, are so arranged that as one enters and passes from one conduit to the other, the lamps may be switched out at the end of the subway and others switched on in advance. The plant has been in constant operation since the spring of 1893, during which time it is said there has been no interruption whatever. The illustrations are reproduced from the *Elektrotechnische Zeitschrift*.

## The Attempt to Extend the Telephone Monopoly.

Brief reference was made in this journal last week to the memorial addressed to Congress by Charles H. Aldrich, ex-solicitor-general of the United States, calling attention to the obvious effect on the telephone monopoly of certain bills introduced in the House to amend the patent laws. From his former official position and from his connection with telephone litigation, as well as from his prominence as a lawyer, Mr. Aldrich's remonstrance is entitled to, and has received, wide attention, carrying conviction to all who have followed it with attention. Since the last issue of the WESTERN ELECTRICIAN was published the complete text of the memorial has come to hand, and as it is of great interest, not only to all interested in telephony, but to all other electrical men affected by patent law, it is given entire. The memorial is entitled "The American Bell Telephone Monopoly and the Pending Legislation in Its Interest," and reads as follows:

An attempt has been made to secure the enactment by the present Congress of an amendment to section 4,887 of the Revised Statutes of the United States, so that a domestic patent shall not be limited in its duration by the expiration of a foreign patent, unless the patent has been granted in the foreign country prior to the date of the filing of the application for the same in this country. In other words, it is proposed that the time shall not commence to run against the monopoly created by a patented invention in this country, notwithstanding the people of every other country are free to use the same invention, by reason of the expiration of the foreign patents thereon, providing only the inventor has filed an application in the Patent Office before he took out his foreign patents.

I have before me at this writing printed copies of proposed bills in which this amendment is embodied as follows: House bill 4,515, introduced December 7, 1893, by Mr. Fielder; house bill 5,014, introduced January 5, 1894, by Mr. Covert; house bill 5,361, introduced January 20, 1894, by Mr. Hall of Minnesota (by request); house bill 6,098, introduced March 3, 1894, by Mr. Hall of Minnesota; house bill 6,597, introduced April 6, 1894, by Mr. Hall of Minnesota.

In the following statement I do not wish in any sense to be understood as imputing to any of the gentlemen who have introduced these bills, or to any member of Congress, any corrupt or improper motives. I distinctly disclaim any such charge. It is my purpose to show that the American Bell Telephone company is vitally interested in this legislation, and that a great wrong would be done the American people should the present law be changed as proposed.

On May 3, 1893, three patents were issued to the Western Union Telegraph company on applications filed by Thomas A. Edison, as follows: Patent No. 474,230, application filed April 27, 1877; Patent No. 474,231, application filed July 20, 1877; Patent No. 474,232, application filed July 20, 1877; and on March 7, 1893, Patent No. 492,789 was issued to the same party on an application filed by the same party on September 5, 1877. These inventions became the property of the American Bell Telephone company by the telephone consolidation contract of November 1, 1879, by which these great corporations agreed to stifle competition, the monopoly of telegraphy being reserved to the Western Union Telegraph company and of telephony to the American Bell Telephone company.

These Edison patents are fundamental, and it is undisputed that if they shall be held not to be limited by the expiration of foreign patents, they, with the Berliner patent now in litigation, as hereinafter stated, and which was delayed or slept in the Patent Office from June, 1877, to November 17, 1891, will easily enable the American Bell Telephone company to prolong its monopoly for seventeen years from the date of the last patent. That the importance of these patents may be appreciated, I quote from the claims of two of them as allowed, viz., Nos. 474,231 and 474,232, as follows:

"In a telegraphic apparatus operated by sound, the combination with the diaphragm of one or more contact points of plumbago or similar inferior conductor in the electric circuit, whereby the rise and fall of electric tension is proportionate to the pressure exerted upon the said point or points by the diaphragm, substantially as set forth." (474,231.)

"A spring forming or carrying one electrode of the circuit of a telephone and constantly pressing against the other electrode and diaphragm to maintain the required initial pressure between the electrodes and yield to the movement of the diaphragm, substantially as described." (474,232.)

These inventions were in constant public use practically from 1878, and assisted in founding a monopoly such as only the modern commercial world has witnessed, and which has existed from that time to the present. Seldom, if ever, has an invention come so rapidly into public favor and returned to those owning it such substantial and, as I think, ample rewards. It has been very ably and intelligently managed, and has unquestionably conferred a great benefit upon mankind. In order that some appreciation may be had of the enormous profit that has been yielded by this invention to its owners, I quote from the testimony of John E. Hudson, president of the American Bell Telephone company, as given on February 15, 1894, in the suit of the United States of America against the American Bell Telephone company, pending in the Circuit Court of the United States for the District of Massachusetts, brought to annul the patent granted to Emil Berliner on November 17, 1891. The extracts are taken from pages 519 and 520 of volume 1 of the record in the suit named.

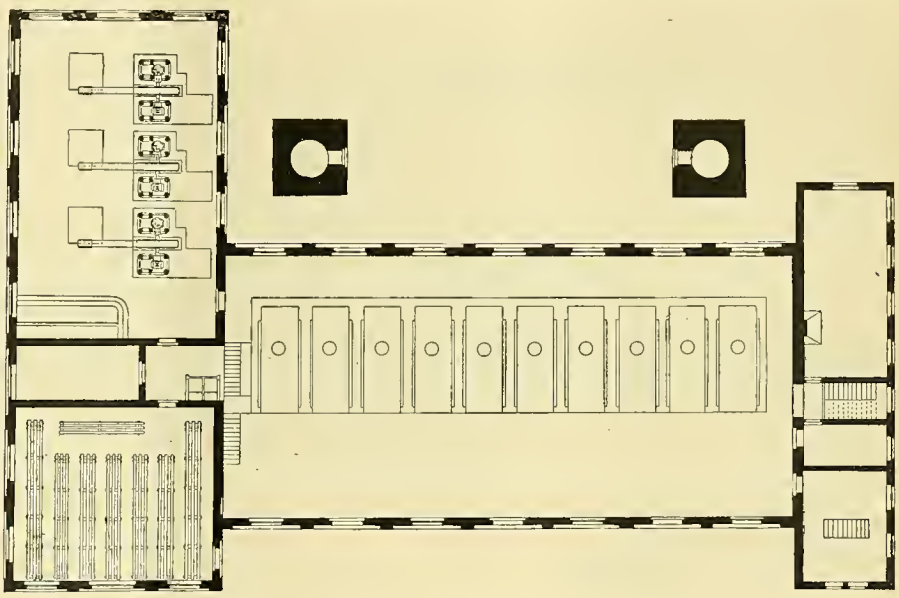


FIG. 1. ELECTRIC ILLUMINATING PLANT OF THE HERZBERGER INSANE ASYLUM, LICHTENBERG, GERMANY.

Ans. The figures giving the net income of the company from 1885 to 1892, both dates inclusive, as follows, are correct:

| Year. | Net Income. | Year's Increase. | Per cent. Gain. |
|---|---|---|---|
| 1885 | $1,809,996.48 | ..... | ..... |
| 1886 | 1,973,350.76 | $163,354 28 | 9. |
| 1887 | 2,237,608.12 | 264,257.36 | 14.3 |
| 1888 | 2,436,462.56 | 198,855.44 | 8.9 |
| 1889 | 2,661,888 69 | 225 425 13 | 9 25 |
| 1890 | 2 869 418.25 | 207.529 66 | 7 8 |
| 1891 | 3,127,819 90 | 257,401 55 | 8 97 |
| 1892 | 3,411,674.78 | 284,854 88 | 9.11 |

It is to be remembered that these vast sums represent the income received by the American Bell Telephone company alone, and there is not taken into account the numerous exchanges established throughout the country, in nearly all of which the American Bell Telephone company owns but a bare majority of the capital stock, and nearly all of which have yielded enormous returns to their owners. But the net income of the American Bell Telephone company will serve as well as the aggregate of all these companies to illustrate the point which I desire to make. Three million four hundred and eleven thousand six hundred and seventy-four dollars and seventy-eight cents is a large net income to ask this Congress to give to this very ably managed corporation for each year for seventeen years to come; it is to be remembered that this is a net income, and represents the residue, after these officers have voted themselves and all their attorneys and agents princely salaries, and paid the expenses, it is to be assumed, of the numerous lobbyists who everywhere seem so zealous in their interests. It is also to be remembered that this tribute which they have so complacently divided, and which they ask you so complacently to continue, comes from the people. If the profits of the subsidiary companies were added, the annual net profit derived from the people would probably be more than double the sum here given.

Members of the present Congress have been told that the proposed amendment is in the interest of the "poor inventor." In order that the truth of this claim may be judged, I quote further from the evidence of Mr. Hudson in the suit heretofore referred to. The quotation will be found on page 526, volume 1 of the record, and is as follows:

"Cross-Int. 99. Do you know what was paid by the National Bell Telephone company or its predecessor, the Bell Telephone company, to Mr. Berliner for the invention covered by his application of June 4, 1877?

"(Question objected to as immaterial.)

"Ans. My memory is that an option was taken upon it; that the option was exercised, and the matter concluded in the early time of the American Bell. I cannot recall the exact amount; $25,000 is the sum that comes into my mind.

"That, however, is not the whole story. The relations between Mr. Berliner and the company have involved also his other inventions and some services; and on the other side considerable payments, in part expressly for the patent in suit, and in part not specially attributed. The price to him of the microphone invention may be stated at $100,000."

One hundred thousand dollars as a sum total to the inventor for all his inventions and services and a net annual income of three million four hundred and eleven thousand six hundred and seventy-four dollars and seventy-eight cents to the purchasing company affords a striking exhibition of solicitude for the "poor inventor."

These inventions of Edison were patented at early dates. In England, France and Canada, in 1877; in Belgium, Austria-Hungary, Italy, Germany and Spain, in 1878; in Prussia in 1882. The art, in so far as these patents are concerned, is free in foreign countries, and, according to numerous decisions of the circuit courts of the United States, is thereby made free in this country. The question has not yet been decided in the Supreme Court of the United States, but is now pending in that tribunal, as pointed out in a communication to me by my client, M. G. Kellogg, a highly responsible and well-known gentleman of Chicago, and also a large owner of telephone stocks.[1]

It will be urged that the examiners in the Patent Office found that the long delay of fifteen years in the issuance of the Edison patents was not the fault of the American Bell Telephone company, but of the office. The same contention is made by the defense in the pending Berliner case. I trust that the statements of complacent or subservient officials to this effect will not be given undue weight. If the claim that this monopoly is prolonged for a total period of thirty-two years through the fault of the Patent Office is true, then I submit that that office ought to be investigated, abolished or—administered. In making this criticism of the administration of the Patent Office, I do not at all wish to reflect upon Mr. Seymour, the present commissioner of patents. His answer to J. J. Storrow, Esq., the leading attorney of the American Bell Telephone company, under date of June 1, 1893, shows such a just appreciation of his duties and of his relations to the other departments of the government, and at the same time such entire independence of action, that I am sure there will be no cause of criticism of that office during his administration. At the same time the fact that the attorney of the American Bell Telephone company could make such a request of the commissioner of patents as is indicated by the answer of Mr. Seymour would seem to indicate that the course of events had been of such a character theretofore that he supposed his wish would constitute a law of the department. The honorable

1. In connection with the institution of the Berliner suit, I would add that the American Bell Telephone company attempted to prevent the institution of that suit by claiming that I was then, as solicitor-general, seeking to serve Mr. Kellogg's interests rather than those of the public. A full refutation of that combined threat and charge is found in the records of the Department of Justice in the shape of a letter from me to the attorney-general and of the latter officer to W. W. Swan, attorney for the American Bell Telephone company. It is a significant fact that this company chose as a medium through which to formulate its charge an officer of the United States—the then commissioner of patents. I would not deign to allude to this matter were it not for the fact that the representatives of the Bell company will seek to meet this exposure of their plans in connection with this legislation by a repetition of similar charges. I beg leave to suggest that my relations to the question are unimportant, if the charges herein contained are well founded.

commissioner's letter is found at page 1,344, volume 2 of the record in the Berliner case.

I respectfully submit that no man in his right senses can believe, as it seems to me, that the Berliner and the four Edison patents were inevitably delayed in their journey through the Patent Office until the original patents to Alexander Graham Bell were about to expire. It will be seen from the testimony of Mr. Hudson in the suit heretofore referred to that the same difficulty has not generally been encountered.

The fact is that these patents were fundamental, and we must believe that the plan was deliberately formed to prolong the monopoly for another seventeen years. Thus a statute enacted pursuant to the enlightened constitutional policy of "promoting the progress of science and of the useful arts by securing for limited terms to authors and inventors an exclusive right to their respective writings and discoveries" is made a means of defeating its own purpose and of wronging and defrauding the people.

I grant that the statute as now construed may work injury in some cases. The contrary construction, either by the declaration of Congress or of the Supreme Court, will cost the people many millions of dollars, and perpetually fasten this monopoly upon the commercial interests of the country.

I, therefore, with the view of doing justice to the "poor inventor" and at the same time of rendering ineffectual this scheme of the American Bell Telephone company and all similar schemes, would suggest that instead of the proposed legislation laws to the following purport be enacted:

1. That the domestic patent shall expire upon the expiration of the foreign patent without reference to the time of application for the patent, and making this law applicable in express terms to patents, or applications therefor, heretofore granted.

2. Providing that when an invention shall be applied for, and shall come into public use, the monopoly shall cease and determine seventeen years from the date of the first public use, without reference to the date of the allowance or issue of the patent. Such an act would protect the people against monopolies for a period longer than that now contemplated by statute, and make the plans by which an invention is held in the Patent Office for fifteen or more years of little avail. This provision should apply to patents heretofore granted. I have no doubt of the constitutionality of such application.

3. Providing that when in any suit in any circuit court of the United States any patent is in controversy in which the patent is not issued within five years of the first application therefor, and the decision is in favor of the validity of the patent, or any of the claims thereof, the party against which such decision is made may appeal the same directly to the Supreme Court of the United States, anything in any other act of Congress regulating or defining the jurisdiction of any of the courts of the United States and appeals therefrom to the contrary notwithstanding. Such an act would make that great tribunal, the Supreme Court of the United States, the final arbiter in this controversy and other like controversies in which so many millions are involved, and in which the people of all parts of the country are interested.

I know that this is an unusual way to present one's views to the representatives of the people in Congress, but I feel assured that I shall be justified both by you and by the people against whom this conspiracy has been planned and so nearly consummated, without the knowledge, I must assume, of any member of Congress.

Mr. Kellogg's letter to Mr. Aldrich, alluded to in the foregoing, is particularly interesting from its reference to the incandescent lamp litigation. It is couched in the following terms:

It is well known and is a part of the official records that in November, 1892, I presented to the Department of Justice at Washington a carefully prepared brief to the effect that the attoney-general should institute a suit in behalf of the United States to annul Berliner's patent No. 463,569, issued to the American Bell Telephone company November 17, 1891, and that on the 9th day of February, 1893, the attorney-general filed a bill in the name of the United States in the Circuit Court of the United States for the District of Massachusetts to annul the Berliner patent. The proofs in the case have already been closed and the cause has been submitted by argument to Judge Carpenter, and his decision is now under advisement.

In November, 1892, I also presented to you certain facts relating to the issue in May, 1892, of three patents to Thomas A. Edison, which patents were controlled and practically owned by the American Bell Telephone company and were for inventions made by Edison as early as the year 1877, and I indicated grounds on which the validity of these Edison patents could also be tested by a suit instituted by the attorney-general to annul them. At the same time I called attention to the provisions of section 4,887 of the Revised Statutes and the decisions of the circuit courts in relation thereto, and submitted for the consideration of the honorable attorney-general, whether in view of these decisions there was in his opinion any necessity for instituting suits to annul these Edison patents. In subsequent interviews with you and Judge Taylor, the special counsel employed by the government, I understood that in view of the decisions referred to and your own views of the construction of the statute no such suit was deemed necessary.

I understand that bills are now before Congress, the effect of which will be to make these patents (with others like them) valid, and give them life until May, 1909, or for thirty-two years after Edison's inventions were made and for thirty-one years after his microphone invention went into public use. The result, if this law is passed, is that until March, 1893, the American Bell Telephone company had had the monopoly of the telephone business through its Bell patents, and then, on account of the issue of the patents on the Berliner and Edison inventions, or either of them, if the patent or patents of the other is held to be invalid, it expects to retain the practical patent monopoly of the telephone business until the year 1908 or 1909, or thirty years and more from the time when all the principal telephone inventions had been made and had gone into extensive commercial use. That such is the scope and protection claimed by the Bell company from its Berliner and Edison patents is shown by its advertisements now printed in electrical journals.

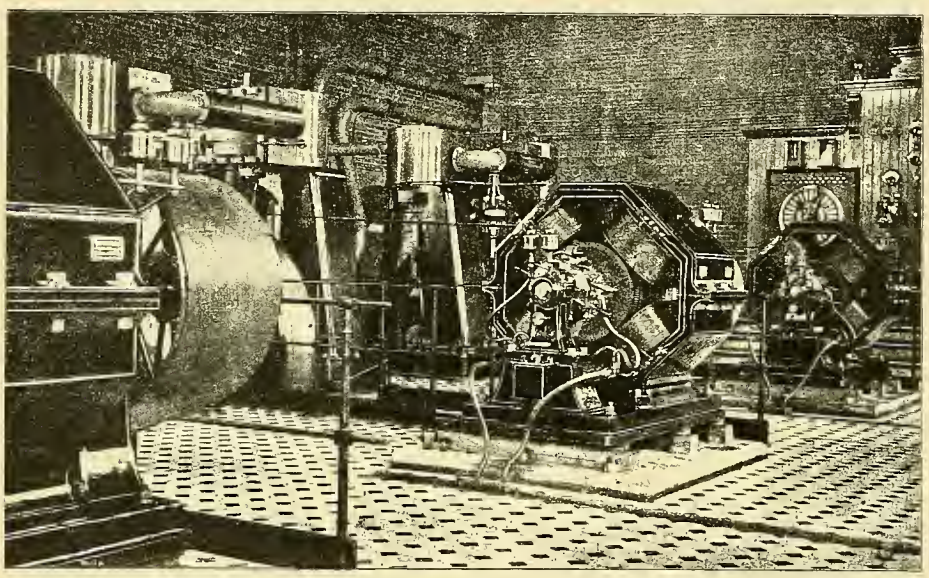


FIG. 2. ELECTRIC ILLUMINATING PLANT OF THE HERZBERGER INSANE ASYLUM, LICHTENBERG, GERMANY.

The General Electric company, with its affiliating companies, has an interest similar to the Bell company's in having section 4,887 of the Revised Statutes construed or modified in such a way as to make valid certain of its electric light patents. On the same favorable construction or modification of this section of the statutes depends the question as to whether the Edison incandescent lamp patent and other patents of the electric light trust represented by the General Electric company, are valid; in other words, whether or not the electric light business, as well as the telephone business of the country, is open to competition.

The legal construction of section 4,887 of the Revised Statutes in so far as it relates to the validity of the Edison telephone patents, as well as the electric light patents referred to, has never been passed upon by the Supreme Court, although, as I have heretofore stated, the decisions of the circuit courts have been uniformly against the validity of such patents. A case unimportant in itself, but in which the principles are involved, has been certified to from one of the appellate courts to the Supreme Court, and will come up for argument at an early date. It is believed that this action is in the interest of the American Bell Telephone company and of the General Electric company, in the hope of getting a reversal of the circuit court decisions in regard to section 4,887. An article was published in the *Electrical Engineer* of January 17, 1894, in which it was pointed out that the appeal is in the interest of these two companies.

It would appear from the bills now before Congress, heretofore referred to, that the interests which desire such a favorable construction of section 4,887, not having confidence that the decision of the Supreme Court will be in their favor, are preparing for an adverse decision by securing if possible the passage of a retroactive law, which will make valid their patents, which were either illegally issued or have already expired in view of section 4,887, or in other words, secure an act of Congress to make valid or renew their patents. I do not know that it appears on the records of the committees of Congress that the American Bell and the General Electric companies are back of the proposed legislation. That such is the fact is, however, apparent, in view of their immense interest at stake, together with the comparatively small interest of others in securing the legislation, the consummate ability with which they are known to guard all their patent interests and the known connection there is between them and the appeal heretofore referred to. It is well known that F. P. Fish, Esq., of Boston, who has charge of the appeal case, is the general and active patent counsel of the General Electric company, and has for years been employed by the Bell company in its patent legislation, and appeared for that company in its defense in the recent and pending suit to annul the Berliner patent.

The interest of the Bell Telephone company in having its Edison patents made valid until the year 1909 is incalculably great, in view of the doubts as to the validity of the Berliner patent and the further fact that there is a question as to whether the Berliner patent covers all forms of practical microphones, while there is no doubt that in view of the present state of the art the carbon of the Edison patents is a necessity in practical microphones. As much as it is to the advantage of the Bell company to have the Edison patents made valid, even so much is it to the disadvantage of the public that they should be legalized. To give figures on this question of pecuniary advantage, there were 283,238 microphones owned by the Bell Telephone company and in use in the United States on December 20, 1893. According to the contracts between the Bell company and its licensee exchanges, the latter are to charge the public $10 per annum for each of these microphones, in addition to a fair price for their lines, service, etc., and are to pay the Bell company $7 per annum for each microphone. There are minor exceptions to these. Therefore the public are paying, approximately, $2,832,380 annually for the microphones in use December 20, 1893, of which the Bell company receives approximately $1,980,000 annually. On account of certain rebates made to the licensees from the contract rates, the Bell company's proportion is somewhat less than the above. Fifteen years' payment for said number of instruments at the above rates would make about $42,000,000 paid by the public, and about $29,000,000 going directly to the Bell company. This does not take into consideration the growth of the business and indirect pecuniary advantages from the maintenance of the Berliner and Edison patents. The electric light trust is also interested to the extent of millions of dollars in having section 4,887 construed or modified so as to save their patents which are in jeopardy.

This is not the first time that the question of modifying section 4,887 of the Revised Statutes has been before Congress. Years ago, before the question of the Edison patents had arisen, efforts were made to have the section modified on substantially the same lines as present effort is directed to. An able firm of patent attorneys then presented a brief to the patent committees of Congress, arguing in favor of a modification of the section, but expressed their opinion that the effect of the modification should not be retroactive so as to make patents valid which were issued previous to the passage of the act. In preparing their brief, they acted on broad views and did not have any axe to grind, either for their clients or themselves. They were practical, disinterested advisers.

I think it would be proper and just to have the statute amended if guarded language is used so as at once to do justice to the inventors and the interests of the public. Of course such a statute would not have the effect of renewing the Edison patents, and of thereby extending the Bell telephone monopoly until the year 1909. In the brief heretofore referred to it was suggested that if the law was amended as suggested by the attorneys, and there were individual cases in which it would be just to extend or renew patents which had already expired on account of the workings of section 4,887, special acts could be passed renewing or extending such special patents. Such a course would certainly meet all the ends of justice. It is certain that no special act would be passsd renewing or extending the Edison microphone patents until the year 1909, on inventions made in the year 1877, and which went into use in the year 1878. Again, if it were thought inadvisable to extend special patents by special legislation, but was thought advisable to make the change in the law retroactive, even then the Edison microphone patents could be excepted by name or by making the law applicable only to patents which are taken out within say two years, or five years, or even ten years after the United States applications were filed. Even the ten years limitation would exclude the Edison patents, as they were not issued until about fifteen years after their original applications were filed in the United States Patent Office.

The testimony of Mr. Hudson, embracing Mr. Lockwood's statistics, is as follows:

Cross-Int. 57. How many telephone patents are now owned by the Bell company?

Ans. I will give as my answer the following letter:

BOSTON, February 14, 1894.

*J. J. Storrow, Esq., 40 State street, Boston:*

DEAR SIR: There have been granted in the United States to January 1, 1894, 805 patents on speaking telephones.

The American Bell Telephone company has owned 160 of them; of these 102 are upon inventions made by persons in the employ of the company, and while in its employ.

There have been granted in the United States to the same date, 2,235 patents relating to calls, switches, conductors, cables and other appliances designed or chiefly designed to be used in connection with telephone systems.

Of these, 274 belong to the Bell company, 187 of which are upon inventions made by persons in the employ of the company and while in its employ.

Yours truly,

THOS. D. LOCKWOOD.

Cross-Int. 58. I am furnished by counsel for defendants with a statement of patents owned by the Western Electric company, amounting to five hundred, which I put in evidence as part of my question as follows:

BOSTON, February 15, 1894

*J. J. Storrow, Esq., 40 State street, Boston:*

DEAR SIR: Of the patents granted in the United States for speaking telephones and telephone appliances up to January 1, 1894 (the number of which I gave you in my previous letter), the Western Electric company owns 500

Of these two are patents for telephones, one of which is an invention made by an employe of the Western Electric company, and the other an invention made by a person not in such employ.

Of the 498 patents on appliances, 390 are for inventions made by persons in the employ of the company and while in its employ, while the remainder, 108, were made by persons outside.

Yours truly, THOS. D. LOCKWOOD.

You may state whether or not the Bell Telephone company is a stockholder in the Western Electric company, or otherwise so associated with it that the patents owned by it are used and expected to be used in the interest of the American Bell Telephone company?

Ans. Patents owned by it are used and expected to be used in the interest of the American Bell Telephone company. They make telephones and other apparatus for us, and for our licensees, and are the sole authorized manufacturers. (Berliner Record, Vol. 1, pages 514, 515.)

When Mr. Aldrich was called upon by a representative of the WESTERN ELECTRICIAN last week and asked if he could throw any additional light on this important subject, he said that he could supplement the statements in his memorial by little that was new, except to add that he was informed that the address had been introduced into the Senate as well as the House. The memorial is undoubtedly in charge of the committee on patents in the former body and it is not unlikely that the committee will be instructed to carefully investigate the charge made in the remonstrance, with authority to send for persons and papers. In that case it is possible that the committee may sit during the recess, but, owing to the low state of the public funds, this plan may be defeated, as many senators are averse to anything that may be criticized as a "junket."

In discussing the situation Mr. Aldrich disclaimed all personal feeling in the matter and was emphatic in the statement that he did not consider that the congressmen introducing the bills were actuated by improper motives. He thought rather that they did not discern the real purport of the measures that they were asked to present. Asked why four bills were introduced when one would answer the purpose equally well, the author of the memorial answered that this course was evidently taken to disarm suspicion. "It is legislation such as that contemplated by these bills—unjustly favoring corporations—that is making anarchistic votes in this country," continued Mr. Aldrich earnestly. "I am perfectly satisfied, as I say in my memorial, that the telephone company has caused these proposed amendments to be introduced in the House of Representatives to secure an added lease of life for its monopoly, to the detriment of the interests of the people. I am ready to do all in my power to defeat the passage of the bill, although, now that the attention of the public is aroused, I have very little fear that they will ever become laws. I have received many flattering evidences of approval of my efforts to make clear the true meaning of the attempted 'reform' claimed for this movement, and I find that the opposition to these bills is very general and widespread."

## Preparation of Solution for Accumulators.[1]

By H. M. Sayers.

In erecting a battery of accumulators abroad the writer had to face the question of preparing the electrolyte on the spot, as shipping it was impracticable. There are obviously some difficulties in making a large quantity of acid solution, and distributing it to the cells; and as it is injurious to the plates to be in the acid for more than a very few hours before charging is commenced, it is necessary to make the whole quantity needed and have means of distributing it at once. In this case about 600 gallons of solution of a density of 1.215 was needed.

Slate, being cheap in the neighborhood, was selected for the mixing-tank, which was made of sufficient size to contain about 25 per cent. excess of liquid. It was made in the usual way, the bottom being grooved to receive the four slabs forming the walls, and the two longer of these slabs being grooved to receive the ends of the others, the whole held together by iron bolts and nuts passing through the overlapping ends of the two longer walls. As the tank was put together the grooves were all painted thickly with anti-sulphuric enamel, and caulked with red lead putty inside and out. The whole inner surface was then painted with two coats of anti-sulphuric enamel and received two pretty thick coats of asphalt, as used for waterproofing walls, put on hot, the angles being all rounded. The tank has given no trouble by leaking. The discharge cock is of ebonite and put in 6 inches above the tank bottom to avoid taking off any sediment. The tank stands on a strong wooden framing, sufficiently raised from the floor of the battery room for the acid to flow by gravitation into the cells, with the tank nearly empty to the cock level. The solution was distributed to the cells by means of a strong rubber hose and some ebonite tubing of 1¼ inch diameter, and a bib-cock on the end of the hose. Filling 60 cells with 10 gallons each of fluid took about six hours, and there was an entire absence of slopping on the floor, connections, etc.

The tank had about 4.096 cubic meters, or 144.77 cubic feet capacity, being 1.60 meters (5 feet 3 inches) cube inside. Taking the mean of two or three tables, acid of 1.215 specific gravity at 15° C. has 29.6 per cent. of monohydric sulphuric acid, this last having 1842 specific gravity at the same temperature. Calculations gave the result that on this basis the tank should be filled to a height of 1.27 meters (3 feet 11½ inches) with water, to which should be added 1,367 kilos (3,007 pounds) of the strong acid, which should give about 3.810 cubic meters of solution. The 600 gallons for the cells being equal to 2.73 cubic meters, the difference made up the space from the bottom to the tap level, and 20 per cent. extra for stock.

The acid used was from the St. Gobain works in France, and was purchased on the spot. As railway and steamship people impose troublesome regulations about transport of acid, which make the freight for small quantities very expensive, it was not practicable to order it specially. The acid marked 1.840 specific gravity was of very good color, and fairly pure. As it was slightly under the 1.842 of monohydric acid about 1,375 kilos were used. The specific gravity of the resultant solution at 15° C. was very exactly 1.215.

The tank was filled with water to the calculated height, and the carboys emptied into it one at a time, slowly and at intervals. Two days were allowed for this mixing, half the acid being put in each day, to avoid excessive heating. The temperature was checked by a thermometer, and thus never rose above 40° C. The tank took three days to cool down to the air temperature. A test of the solution showed that it contained a distinct amount of metals of the "arsenic and copper groups," mostly arsenic apparently, but no detailed analysis was made. Iron was also present, but is not considered prejudicial to cells as far as the writer knows. It was thought advisable to get rid of the arsenic, etc. To precipitate these metals by the passage of sulphuretted hydrogen would have been a most annoying and troublesome process, and seemed impracticable for various tolerably obvious reasons.

The following plan was thought of and carried out: Sulphuretted hydrogen was prepared in the ordinary way in a hydrogen generator as used for lead-burning, connected to a small gas-holder, to allow of regulation of pressure of the gas. This hydrogen generator and gas-holder had served for the lead-burning needed in erecting the battery, and were therefore at hand. From the gas-holder a branch was connected on to a lead tube soldered into the center of a sheet of lead a foot square, with the edges turned downward. This was immersed in a lead battery box, the corners of the lead tray or sheet being supported an inch or so above the bottom of the box. The box was filled up with a strong solution of caustic soda, about 22 pounds in about five gallons of water. The tray obliged the gas to pass over a large surface of the soda solution before it had a chance of escaping upward. The pressure on the gas-holder was then adjusted until only a very occasional bubble escaped from under the tray, thus insuring as nearly as possible a complete absorption of the gas by the soda. As a matter of fact, very little gas escaped, and no serious annoyance was caused in the building. A solution of a sulphide of soda was thus prepared, and this was added in small doses to the sulphuric acid solution, a funnel with a leaden pipe reaching to the tank's bottom being used to insure a complete action on the whole body of liquid. Each addition of this solution produced a most violent agitation in the acid liquid, and promoted its complete mixture better than hours of paddling would have done, though a paddle was also used during the two days of mixing. The liquid was very turbid after this treatment, but settled in the course of three or four days, the sulphides precipitated, falling below the cock level of course. The clear liquid gave no precipitate with sulphuretted hydrogen, showing its freedom from the objectionable metals. About 30 pounds of crystalized sulphate of soda was added to the solution afterward.

The battery for which this solution was made has been in use over a year, giving very good results, partly due, certainly, to the absence of objectionable metal in the electrolyte.

The purple or permanganate-like coloration during charging is very pronounced in these cells. It seems to the writer to be produced solely at the positive plates, which it envelopes like a thick skin during the middle part of the charging time, slowly diffusing with the circulation of the acid at the sides and ends of the cell, but always keeping away from the negative plates. It would, therefore, seem to be a result of oxidation, probably of iron present in the solution. Possibly the presence of sodium may assist in its production; but, as the writer has not investigated the matter, these are only guesses, of little value except for basing experiments on.

It may be added that the preparation of these four tons of strong acid solution was carried out without material damage to person or property, the worst accident happening to a man who kicked over an opened carboy, and fell on top of it. His nether garments were a sad sight afterward. A large quantity of whitening was kept at hand for the purpose of soaking up any acid spilt. This is better than soda, ammonia or sawdust, because it is very cheap, and both neutralizes the acid and remains in a solid state easily removed and inoffensive. It should be kept in every battery room. A bottle of ammonia for application to clothes and skin in case of need is an obvious precaution; but for acid on the face or other tender part plentiful cold water at once and oiled rags afterward if the skin is destroyed are the best remedies. The writer once got strong sulphuric acid in one eye, but immediate and forcible application of cold water prevented permanent damage.

1 From the London *Electrician*.

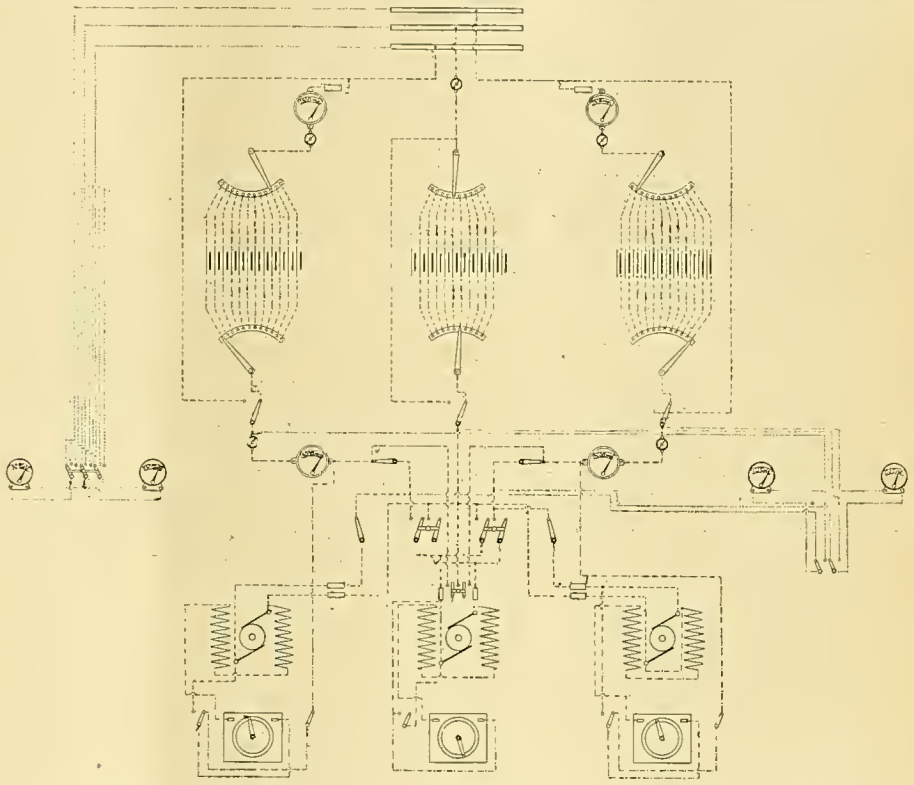


FIG. 3. ELECTRIC ILLUMINATING PLANT OF THE HERZBERGER INSANE ASYLUM, LICHTENBERG, GERMANY.

## Duty of Persons Crossing Electric Railway Tracks.

The measure of duty for a pedestrian who crosses a public highway traversed by surface cars propelled by electricity, the Court of Errors and Appeals of New Jersey holds in the case of Connolly against the Trenton Passenger Railway company, is to use such precaution and care for his safety as a reasonably prudent man would use under the circumstances. The circumstances thus adverted to include the presence of other vehicles, the direction and rate of speed at which they are being driven, their nearness to the foot passenger, and the apparent imminence of danger from them, together with the distraction of attention reasonably attributable to their presence and behavior. To say that under all circumstances the legal duty of the traveler is to exercise the fullest measure of care to look out for and avoid one species of vehicle alone, or chiefly, is to clothe that vehicle and others of its class with privileges not only greater in degree, but different in kind, from all others that may be lawfully using the surface of the public highway. Such privileges are, by virtue of legislative grant, possessed by railroads operated by steam, but have not been extended to railways of the class under consideration. A car of such a railway, while running on the streets of a city, is simply one vehicle more using the public highway. Whatever peculiarity it exhibits by virtue of its inability to deviate from its tracks, its customary rate of speed and the like are circumstances that a prudent man would take into consideration in common with all others that were at the same time forced upon his attention. If other vehicles threaten his safety, or if his attention is engrossed or distracted by the apparent imminence of danger from other sources, he must act with ordinary prudence, with reference not to any one source of danger as paramount, but with reference to the group of circumstances that make up the situation with which he is confronted. How a prudent man would act in the face of concurrent and distracting dangers must, in the nature of things, be a question of fact to be passed upon by the jury, and not a question of law upon which the court may order a nonsuit or direct a verdict.

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ONE of the papers presented at the convention of the Association of Edison companies at Boston last week was by W. L. Barstow of Brooklyn and described the "Low Tension Arc Lighting System" used by the Brooklyn company in lighting the central portion of the city from the low tension mains of the Edison company in a manner never before attempted, this being the first instance in America where street lighting has been attempted from the low tension mains of the regular Edison underground system. This project had to be developed in all its details, including lamp posts, automatic clocks and kindred devices. The paper contained some data which it was claimed established the fact that this form of lighting would be a valuable adjunct to central station business. However, as this information was not made public its value cannot be safely estimated, and for all practical purposes the effect of the paper is lost upon station managers generally who might be inclined to investigate this subject.

THE suggestion has been made that the National Electric Light association and the American Street Railway association combine, and it is pointed out that in many respects the interests of these organizations are identical. The National Electric Light association has of late been trying to interest the street railway men in its work, and special inducements have been held out to them to join in the proceedings of the association. At the last meeting, it will be remembered, considerable prominence was given the reading and discussion of a purely street railway paper. However, it is hardly to be expected that the associations will combine at once, although a joint meeting next year might be arranged. Many members of the National Electric Light association have become interested in street railway enterprises, and in some cases lighting and railway plants are operated by the same concern. By combining both of these organizations, it is contended, a much more powerful association could be established, and its influence would be greater than that of two weaker societies working separately. The subject will bear discussion at the coming conventions.

FOLLOWING the policy which has governed its former meetings, the Edison association at its convention last week declined to make public its proceedings or any part of them, contenting itself with the publication of a synopsis of the minutes, giving the titles of the papers read and the names of the authors. Of course, the association had a perfect right to conduct its meetings secretly if it so desired, but it seems at this late day as if a much more liberal policy would be in order. It is contended that the "Edison system" has been established by hard and persistent investigation and experiment, and at great cost to those engaged in its development. It is, therefore, claimed that it would be an injustice to ask those who brought about the development of this system to relinquish the profit and advantage to which their work entitles them. But the companies represented in the association are not confined to the operation of Edison apparatus; in fact, in some cases, it forms only a small part of the equipment. It may be, however, that by keeping the present plan of organization better attendance is secured at the meetings and more attention is given to the proceedings. It is a noteworthy fact that every session of the convention was well attended, the delegates devoting their undivided attention to the proceedings. In this respect the example of the Edison association is commended to more pretentious organizations.

WHATEVER may be said of the North Chicago Street Railway company it must be admitted that that corporation has made an honest effort to improve the service on its horse car lines and find some practical method which would supplant animal power. In the course of these investigations a series of experiments were conducted with gas engines and according to Superintendent Roach they have been found impracticable for street railway service. Speaking of their experience that official said: "Gas engines are all right in theory, but they are away behind the times. Our company has spent $75,000 in buying, building and improving gas motors all to no purpose. It now has gas motors to sell. They made too much noise. The link belt machinery and the exhaust of the engine was too much for even the Chicago public. So we took the motors off of the cross lines where we were using them and employed horses again." The company's experience with steam motors was equally unsatisfactory and finally it was determined to discontinue experiments in this line. Several types of storage batteries were also tried, but these were not adapted to the heavy business of the lines where they were desirable. Mr. Roach sums up the present situation as follows: "Is is my impression that the people of Chicago will keep the present cable and horse car system until it can be supplanted by electricity, which everybody realizes is to be the great motive power of the future. Gas motors and the like will be back numbers henceforth." It is gratifying to learn that a man of such practical knowledge as the superintendent of the North Chicago system should thus openly advocate the electric motor, especially in view of the fact that his company heretofore has been the acknowledged representative of the cable system.

THERE is nothing so convincing as practical experience, as is shown in the paper recently prepared by H. D. Wilkinson for the Institution of Electrical Engineers of London on "Electric Tramways in the United States and Canada." The author gave considerable time to the study of the methods employed in this country, and his investigations were not confined to one locality or one system of street railway propulsion. His conclusions show that he was particularly well pleased with the results obtained by the trolley roads. He calls attention to the fact that for short distances people will not go out of their way to get on the railway or climb steep staircases to elevated roads, provided that the surface cars travel at a reasonable speed, with minimum delay. Mr. Wilkinson advises his English friends to adopt the American practice of not stopping between "blocks," while for a reasonable speed he says they must look to other means of propulsion than horses. "The cable system," he says, "is suitable in certain localities, such, for instance, as on straight and hilly roads, but the wear and tear of cable is enormous on curves. Steam is unsightly and obnoxious. Electricity affords at once rapid and noiseless travel, quick control, with small wear and tear, and the current can simultaneously be utilized for heating and lighting the cars. As a means of travel, I have not experienced in the states anything so pleasant as their well-lighted and fast-moving electric street cars; and I cherish the hope that ere long this public boon may be extensively put into action along the streets and lanes of our own country." Many of our contemporaries will no doubt be shocked to learn that Mr. Wilkinson has taken such a common sense view of the situation. But the English people as a rule will support this position as soon as they come to realize the advantages to be gained by the adoption of the much-abused trolley.

THE memorial to Congress by Charles H. Aldrich, ex-solicitor-general, on the subject of the extension of patent protection to the American Bell Telephone company, which is published in full in this issue, is very instructive reading. Is it not consummate assurance for a corporation which has already, under existing patent laws, extorted at least thirty millions of dollars, and probably much more, from the American people to now come forward and seek to secure the enactment of laws which will extend its monopoly for seventeen years longer? Was there ever such magnificent audacity?—and all, too, in the name of the "poor inventor." Surely this corporation has attained the very pinnacle of monopolistic presumption. It has reached the flood in the tide of its arrogant career, and, failing, as it inevitably must, to secure the desired modification of the patent laws in its interest, its course will henceforth be downward. Not that the American Bell company will cease to be a great factor in the telephone business. It will be many long years, if ever, before that result is brought about. But it must be assumed that the company has reached the end of its tether in "jockeying" with patent laws, intended to protect the inventor in the product of his brain, but which, by the dextrous manipulation of some of the keenest legal minds in the country, have been made the cloak for shameless injustice. Henceforth the company must meet a constantly growing competition—a competition which will be compensated for many disadvantages by the deep-seated resentment in the minds of the American people.

It will be charged, doubtless, that Mr. Aldrich is actuated by interested motives in making this crusade against the American Bell Telephone company, as he has been professionally retained in telephone litigation. But that has nothing to do with the main issue. Are the statements in his memorial true? They are, beyond question; and if Mr. Aldrich has made out his case before Congress and the people, it does not matter, so far as the relation of the public and the telephone company is concerned, what lies at the root of his investigation. If the motive is selfish, let us hope that a similar selfishness may always manifest itself when the rights of the people are threatened by vicious legislation.

THE legal status of street railway companies in many respects has not been fully established and interesting points for adjudication are being constantly raised. This has been especially noticeable since the introduction of the trolley system, which has revolutionized street railway practice. An interesting point raised in a New Jersey court recently was the measure of precaution which a pedestrian should take in crossing the tracks of a street railway company. It was admitted that special privileges had been granted by legislatures to railroads operated by steam, but it was contended that this enactment did not extend to street railways operated by electricity. This latter view was sustained by the court, which ruled that "a car of such a railway, while running on the streets of a city, is simply one vehicle more using the public highway. Whatever peculiarity it exhibits by virtue of its inability to deviate from its tracks, its customary rate of speed and the like, are circumstances that a prudent man would take into consideration in common with all others that were at the same time forced upon his attention." The court adds: "To say that under all circumstances the legal duty of the traveler is to exercise the fullest measure of care to look out for and avoid one species of vehicle alone, or chiefly, is to clothe that vehicle and and others of its class with privileges not only greater in degree, but different in kind, from all others that may be lawfully using the surface of the public highway." If this be true, the decision may be turned to the advantage of the street railway companies. Why should they be compelled to pay such exorbitant taxes, special assessments and licenses if they are not in return to enjoy special advantages? For instance, in the case of the street railway company of Milwaukee the city has levied a very heavy tax upon the company and the City Council assumes to make provisions for the operation of the cars. Why should the company be compelled to recognize the power of the city council to make these regulations unless through the favor of the council it enjoys some special privileges? No merchant would tolerate such interference by city officials. Corporations, such as street railway companies, deserve equal consideration and their rights should be respected.

## Convention of the Association of Edison Illuminating Companies at Boston.

This year's meeting of the Association of Edison Illuminating Companies was held on Tuesday and Wednesday, August 14th and 15th, at the Vendome Hotel, Boston, Mass. As has been the custom the association met behind closed doors, and although electrical newspaper men appeared ready to place columns of space at the disposal of the Edisonian disciples, it will be seen from the following meager account, which was all that could be obtained, that the members, like the renowned inventor himself, fully appreciate the wisdom of not trusting entirely to patents but of carefully guarding useful pointers in Edison central station practice and keeping them only for the use of those whose hard work and experience in developing them has justly entitled them to the exclusive possession of inside information.

On Monday night the delegates began to arrive in Boston, and a party of about fifteen visited Tremont Theater to listen to the comic opera "Madeleine, or The Magic Kiss." Tuesday morning saw the majority in attendance at the Vendome, and at about 11 A. M. the first session of the convention was called to order.

It was a notable fact that this convention differed from the meetings of the National Electric Light association in that the members attended to business with a closeness of application that was remarkable. There was no question, either, as to whether the statement that the sessions would be held with "closed doors" had a plain and definite meaning, and that those who were not of the chosen few would be on the outside. Following is a brief summary of the proceedings, as given out by W. S. Barstow, secretary of the association, showing the order of proceedings and the topics discussed.

*Tuesday, First Session.*

Roll call; admission of new members; report of committee on "Lightning Protection, Crosses and Grounding of the Neutral;" discussion, A. E. Kennelly; Messrs. Beal, Field and Weeks appointed committee on election of officers; Prof. Marks, paper on a "Board of Control;" discussion; R. S. Hale, paper on "Boiler Tests in the Atlantic Avenue Station of the Edison Electric Illminating Company of Boston."

*Tuesday, Second Session.*

Roll call; J. H. Van Vleck, paper on "Switchboard of Edison Electric Illuminating Company of New York;" discussion; A. D. Page, paper on "Incandescent Lamps;" W. S. Barstow, paper on "Low Tension Arc Street Lighting System," followed by discussion of "Methods of Electrical Distributon Used by the Boston Illuminating Company."

*Wednesday, First Session.*

R. R. Bowker's paper on "Storage Batteries" was read by J. W. Lieb, who also read another paper prepared by himself on the same subject. Next a committee was appointed as follows to report exhaustively on storage batteries, their improvement, etc.: J. W. Lieb, chairman; C. P. Gilbert, Louis A. Ferguson, W. D. Marks and C. L. Edgar. Officers for next year were elected as follows: C. L. Edgar, vice-president and general manager of the Edison Electric Illuminating company of Boston, president; A. L. Smith of Appleton, Wis., vice-president; W. S. Barstow of Brooklyn, N. Y., secretary; J. W. Lieb of New York, treasurer; executive committee, John I. Beggs, chairman; C. P. Gilbert, Detroit, Mich.; E. R. Weeks, Kansas City, Mo.; W. D. Marks, Philadelphia, Pa.; G. R. Stetson, New Bedford, Mass.; C. L. Edgar, ex-officio.

*Wednesday, Second Session.*

An address was delivered by C. A. Coffin, of the General Electric company, relative to matters of policy between licensees and the parent company, which have not heretofore been clearly understood. W. L. R. Emmet then addressed the convention on the "Relative Advantages of Direct and Alternating Currents for Distribution of Light and Power;" discussion. The meeting was then adjourned at 6 P. M., after it had been decided to hold the next convention in Detroit, Mich., August 14, 1895.

*Social Features.*

On Tuesday evening a party of about fifty of the convention members spent the after-dinner hours at the Boston Museum listening to the opera "Davy Jones." Wednesday morning, bright and early after breakfast, five dragloads of energetic delegates were driven out for a "bracer." They made the trip out through Beacon street to the Brookline reservoir, around it and into the edge of Newton, then to the Country Club estate, past the beautiful residences in that vicinity, by the Jamaica Pond and through the Black Bay Fens home to the Vendome.

The hotel was reached at 10:30 and then the delegates, who said that they had never seen so many beautiful spots in so short a time before, and showed especial pleasure at the Boston park system, alighted and again went into sedate convention at 11 o'clock at the Verdome, listening to the papers which were not reached at the session the day before.

Thursday morning the delegates visited the power station of the West End Street Railway company and the Third District station of the Edison Electric Illuminating company of Boston, on Atlantic avenue. From there they went to the works of the General Electric company at Lynn. After an inspection of the factory the visiting delegates were entertained at dinner by the General Electric company.

EXHIBITS.

The Davidson Ventilating Fan company of Boston distributed a handsome catalogue.

Lundell fan motors and a very compact dental motor equipment reminded the delegates that Pettingill, Andrews & Co. were looking after the Lundell interests.

Only a few electrical firms made exhibits at the convention, and those who were on the ground had only the short time between sessions in which to present their goods, for few if any of the members remained away from the meetings.

General Agent H. W. Weller, assisted by E. F. Webster, did good work in making friends for the Solar Arc Lamp company of New York. Mr. Weller exhibited two solar lamps, an ornamental "Bijou" of polished brass finish and the company's standard lamp for inside or outside service, which is made with a black rust-proof finish and fitted with a hood. It is claimed for the solar lamp that it has in it no spring, no dash-pot, no dead weight; the feed is positive. The Solar company is now pushing its lamps most aggressively in the East, and before long without a doubt will find it advisable to begin an extension of its business into the western market, where such high-class electrical specialties are finding ready sale.

The General Incandescent Arc Light company of New York was represented by President S. Bergmann, Treasurer P. H. Klein, Jr., Electrician H. O. Swoboda and Western Agent L. E. Frorup of Chicago. The company had in the convention parlors at the Vendome several of its latest and most improved electrical specialties. The new Bergmann arc lamp for constant potential circuits was shown for the first time and excited considerable comment. The mechanical simplicity of this new lamp commended it, for it consisted practically of only two wheels and one magnet. There are no springs and no escapement in this lamp. The new Bergmann "Twin" arc lamp for constant potential circuits was shown burning in the parlors, and it likewise won many friends. In this lamp the two lower carbons are carried on an inverted "T," so to speak, the leg of the "T" extending up to the lamp proper and thus forming a support or hanger for the lower carbons which, being located midway between the arcs, reduces the "shadow loss" to a minimum. Bergmann switches for central stations, all copper and not cast, were shown in sizes up to one of a capacity of 1,750 amperes. This concern, however, has made switches to carry as high as 10,000 amperes.

Two large, curious-looking instruments standing on the floor of the outside parlor, exhibited by the Weston Instrument company of Newark, N. J., excited considerable interest among the central station men. These "Jumbos" were two Weston amperemeters designed for the Van Vleck "edgewise" system of electrical apparatus. These meters, one a feeder meter for 1,000 amperes, the other a dynamo ampere meter for 7,000 amperes, as explained by Mr. Van Vleck, are so constructed on the "edgewise" plan that they may be placed in rows like books on a shelf, instead of "face on," like a row of ordinary clock-faced instruments, when hung on a switchboard, and thus occupy a surprisingly less amount of valuable room. No better illustration could be found of the progressiveness of the Weston Instrument company than its taking up these two improvements in the line of instruments suitable and eminently practicable for the growing needs of modern constant potential low tension central stations. And from the number of critical examiners at this convention who handled these meters, it is only fair to presume that the near future will bring more substantial evidence than this of the manner in which the good points of the new "edgewise" instruments are appreciated.

The delegates found quite an interesting exhibit arranged for their inspection at the Lynn works. There were shown in operation Prof. Thomson's high frequency induction apparatus; a 300 kilowatt alternating dynamo, single phase, high periodicity; arc lamps for constant potential direct current circuits; arc lamps for power circuits; a large variety of Thomson recording wattmeters, and a street railway truck equipped with two GE-800 motors and series parallel controllers. In addition there were shown various sizes of alternating dynamos, four 200 kilowatt transformers built for the Cataract Construction company, Thomson recording wattmeters, lightning arresters and miscellaneous supplies. The principal features of this apparatus and its operation and care were fully explained by experts of the General Electric company. It was a very practical and interesting exhibit. Special attention was called to the Thomson '93 lamp for meeting all the requirements of constant potential arc lighting, and the large transformers constructed for the Cataract Construction company came in for their share of attention. Probably the most interesting part of the exhibit was Prof. Elihu Thomson's apparatus for the production of discharges of high frequency and high potential. This apparatus uses the ordinary alternating current, which, by a transformer, is raised to 20,000 or 30,000 volts potential at a frequency of about 125 cycles. This potential is allowed to charge a large condenser and then discharge over an air gap, across which an air jet is kept blowing, thus producing high frequency currents. This high potential and high frequency current of, say 30,000 volts, is then passed through a primary coil immersed in oil, which because of the high frequency need be of but a few turns, and induces in a parallel secondary coil of a much larger number of turns, also immersed in the oil vat, a potential which may be almost without limit. In the apparatus shown at the World's Fair currents having an estimated potential of 500,000 volts were produced. Such discharges produce effects similar to lightning and are particularly interesting because of their comparatively harmless effect when passed through a person's body. Thus sufficient current to brilliantly light an incandescent lamp can be carried through the body producing only a slight sensation. The apparatus can be used to demonstrate very conclusively that ordinary water, not containing much salt or acid, behaves for such discharges very much as an insulator.

DELEGATES AND VISITORS.

Following are the names of the members who took part in the sessions:

Francis A. Upton, general manager lamp works, General Electric company, Harrison, N. J.

George R. Stetson, president and general manager New Bedford Gas & Edison Light company, New Bedford, Mass.

C. P. Gilbert, secretary and manager Detroit Illuminating company, Detroit, Mich.

C. L. Edgar, vice-president and general manager Edison Electric Illuminating company, Boston, Mass.

E. R. Weeks, general manager Edison Electric Light & Power company, Kansas City, Mo.

Warren B. Reed, electrician Edison Electric company, New Orleans, La.

A. L. Smith, president Appleton Edison Electric company, Appleton, Wis.

A. E. Kennelly, Philadelphia, Pa.

R. S. Hale, Edison Electric Illuminating company of Boston.

William D. Marks, president Edison Electric Illuminating company of Philadelphia,

A. G. Pierce, Edison Electric Illuminating company of Boston.

J. Van Vleck, chief electrician and consulting engineer Edison Electric Illuminating company of New York.

Howard Rinck, general manager Edison Electric Illuminating company, Easton, Pa.

J. W. Lieb, Jr., assistant general manager Edison Electric Illuminating company of New York.

Luther Stieringer, Boston Edison company.

J. E. Pyle, superintendent Edison Electric Illuminating company, West Chester, Pa.

A. W. Field, secretary and manager Edison Electric Light company, Columbus, O.

J. A. Colby, general manager and treasurer Des Moines Edison Light company, Des Moines, Ia.

M. A. Beal, secretary, treasurer and director Forest City Electric Light & Power company, Rockford, Ill.

John R. Markle, director Edison Light company, Grand Rapids, Mich.

Louis A. Ferguson, electrical engineer Chicago Edison company, Chicago, Ill.

John Wolff, superintendent steam plant Edison company, Brooklyn, N. Y.

F. E. Jackson, Edison Electric Illuminating company, Brooklyn, N. Y.

George Cato, electrician Detroit Illuminating company, Detroit, Mich.

E. W. Rice, Schenectady, N. Y.

E. A. Armstrong, president Camden Electric Light company, Atlantic City, N. J.

J. Willard Morgan, Electric Light company, Atlantic City, N. J.

W. S. Barstow, general superintendent Edison Electric Illuminating company, Brooklyn, N. Y.

John I. Beggs, vice-president and general manager Cincinnati Edison Electric company, Cincinnati, O.

W. J. Jenks, legal department General Electric company, New York.

A. D. Page, lamp works, Harrison, N. J.

N. C. Stevens, manager Edison Electric Illuminating company, Brockton, Mass.

Charles E. Pattison Edison Electric Illuminating company of Boston.

Charles Wirt, electrical engineer, Chicago, Ill.

I. E. Moultrop, Edison Electric Illuminating company of Boston.

R. Lindsay, Cleveland Electric Illuminating company, Cleveland, O.

W. S. Clark, General Electric company, Schenectady, N. Y.

W. M. Anthony, comptroller Chicago Edison company, Chicago, Ill.

A. S. Knight, auditor Edison Electric Illuminating company of Boston.

Caryl D. Haskins, electrical engineer General Electric company, Boston.

J. R. Lovejoy, general manager supply department General Electric company.

S. D. Greene, general manager lighting department General Electric company.

W. H. Wofrekamp, Edison Electric Illuminating company of Lawrence, Mass.

H. T. Edgar, Edison Electric Illuminating company of Atlanta, Ga.

Charles R. Price, treasurer New Bedford Gas & Edison Light company, New Bedford, Mass.

There were also in attendance the following:

George M. Phelps, *Electrical Engineer*, New York; R. F. Ross, *Electrical World*, New York; B. E. Greene, *Electricity*, New York: Frank L. Perry, WESTERN ELECTRICIAN; S. Bergmann, New York; P. H. Klein, New York; H. O. Swoboda, New York; L. E. Frorup, Chicago; G. W. Davenport, New York; C. T. Hughes, New York; P. H. Alexander, New York; G. A. Redman and wife, Rochester, N. Y.; H. W. Weller, New York; B. B. Corry, New York. Judge Armstrong's party, consisting of Mrs. W. F. Armstrong, Miss E. W. Armstrong, Miss C. W. Morgan, Mr. J. Willard Morgan and Master Wynn Armstrong.

## COMMUNICATION.

### Long-distance Telautography in England.

*To the Editor of the* WESTERN ELECTRICIAN:

I notice that the *Electrician* of London has the following mention of the telautograph:

"By permission of the postal authorities the wires between St. Margarte's Bay and the general postoffice were last Sunday afternoon and evening used for the purpose of some experiments with the telautograph. Special instruments were fixed up at both ends, and as this was the first time that long-distance experiments in telautography have taken place in this country, they were watched with interest. The results were successful. Armytage Bakewell writes to the *Times* from Hampstead: 'It has been stated that the recent experiments in the transmission of autographic messages by electricity between St. Margaret's Bay and London were the first which have been made in this country in long-distance telautography. Will you allow me to point out that this is a mistake, as more than forty years ago the copying electric telegraph, invented by the late Frederick Collier Bakewell, successfully transmitted autographic messages between Brighton and London. Invisible messages, which could be rendered legible by the recipient, were also transmitted by that system. Great interest was taken by the late prince consort in my father's invention, and the inventor had the honor of exhibiting the instruments and of explaining their mechanical and electrical details to his royal highness at Buckingham Palace. The copying electric telegraph was subsequently exhibited at the great exhibition of 1851, and received the highest award, viz., the council medal.'"

The exception taken by Mr. Bakewell to the statement that the experiment in long-distance telautography made between St. Margaret's Bay near Dover and London was the first ever made in England is, at least, misleading to the general public. Of course everyone versed in telegraphic history knows that the principle of the system used by Bakewell and that employed in the telautograph are radically different. The Bakewell, better known as the Rasselli method, prepares the message before it is sent by means of insulating ink on a conducting surface and then it is put into a machine which, by means of a stylus, draws straight lines close together over the prepared message until the whole is covered. A stylus at the receiving end moves synchonously with that at the transmitting end in contact with chemically prepared paper. The result is a *fac simile* record in either black or white dotted lines according to the way the message has been prepared.

The telautograph transmits the actual movements of the pen or pencil of the person writing the message to the receiving pen, which moves as though it were a part of the transmitting pen. Both systems are *fac simile*, but both are not telautograph. Hence the statement that the experiment between St Margaret's Bay and London on the 22d of July, 1894, was the first long-distance experiment in telautography is correct. Very truly yours,

ELISHA GRAY.

*Highland Park, Ill.*, August 11, 1894.

### The Corrosion of Iron Pipes by the Action of Electric Railway Currents.

In the discussion of the paper on this topic before the Western Society of Engineers at Chicago, July 11th, the stenographer of the society reported Prof. Jackson as saying, in reply to the question as to what objection the company had to putting in the return wire:

The actual cost of circuit is increased about three-fold. It requires four times as much power of the same potentiality in the circuit and four times the amount of copper. Of course the labor of insulation is considerably cheaper.

Prof. Jackson says this statement was not made by him but by another member and that it does not correctly represent his position in the controversy.

An electric car mail service is contemplated between Jonesboro and Gas City and Marion, Ind.

The *Bulletin International de l'Electricité* describes a portable electric pump devised by Carl & Co. of Worms, for use in breweries and cellars. The motor and pump are arranged on a kind of trolley, the former driving the latter by means of worm gearing. The motor is put into the circuit of an existing electric light installation by means of a flexible cable, which is connected to any one of the various wall plugs in the building. The motor is made in sizes ranging from ⅓ horse power to ¾ horse power, and the plant is said to be more economical than pumping by hand.

### Plant of the Mather Electric Company.

The plant of the Mather Electric company, shown in the illustration, covering a number of acres, is situated in Manchester, Conn., directly on the main line of the New York & New England railroad, which, together with a spur track running directly into the company's erecting shop, allows it to load heavy generators directly on the cars and gives it the best of facilities. The company has recently completed an extension to its plant in the form of an iron building, 300 by 50 feet, for an erecting shop, constructed by the Berlin Iron Bridge company, East Berlin, Conn., and fitted with a 50 ton Shaw electric traveling crane, which, together with a large amount of new machinery which the Mather company has recently installed, consisting of heavy planers, boring mills, radial drills, lathes, etc., enables it to handle large generators of over 500 kilowatts capacity. The Mather Electric company is making a specialty of both belted and directly connected work, especially for railway and power purposes. Its facilities for testing generators, from the smallest to the largest, under most severe conditions, are second to none, its steam plant being especially arranged and adapted for this purpose. The Mather company already contemplates another extensive addition to the plant, to accommodate large work, and new battery of boilers and engines especially for testing this class of apparatus. The entire plant of the Mather company is operated by electric motors, sizes varying from five to fifty horse power, which system of transmission and sub-division of power it has found exceedingly satisfactory and economical in the operation of its works.

MANHATTAN INCANDESCENT ARC LAMP.

PLANT OF THE MATHER ELECTRIC COMPANY.

### Manhattan Incandescent Arc Lamp.

The Manhattan incandescent arc lamp, manufactured by the Manhattan General Construction company, New York, is shown in the accompanying illustration. This lamp combines fewness of working parts and decrease in cost of repairs, economy in trimming and in carbons, an enclosed globe to act as a spark arrester, an arc lamp that will burn singly with economy on incandescent circuits and a lamp that is positive in cutting out. In the lamps of this make for exterior lighting the main line circuit runs through a switch in the cap, and the lamp may be removed and the circuit left uninterrupted. The wires enter the cap through inclined insulated openings which exclude the weather. To shorten the lamp, the customary carbon rod has been dispensed with and a thin sheath or holder feeding through the clutch rings with bare carbons substituted. A cushioned clutch feed is provided, which gives a perfectly smooth and imperceptible feed.

The most important feature of the lamp, covered by broad patents, is the enclosed globes. The outer globe is airtight at all points except at the bottom, where there is a hand hole large enough to permit of cleaning and trimming the lamp. This handhole is yieldingly closed by a detachable dust pan. This is the only practical method of preventing the oxidation of carbons by closure, as it makes it practical to trim the lamp without disturbing any airtight bearings. The upper opening of the outer globe is secured to the carbon frame and there made airtight by abestos gaskets, the globe and frame screwing into the body of the lamp.

Within this enclosing globe, and immediately surrounding the arc, is a smaller globe, into which the carbons are fed, there being, however, no airtight bearings. The inside globe acts as a chamber of high rarefaction, while the outer globe is a storage for the products of combustion, or diluting chamber, thus preventing access of air containing oxygen to the carbon points. On the formation of an arc, the enclosed air is heated and rarefied, the surplus air escaping through the lower vent. The contained oxygen is soon reduced by combustion with the carbon points to carbon monoxide and this, with the remaining nitrogen, surrounds the arc and protects the points from further combustion.

By this system of burning of carbons in these enclosed chambers, half-inch carbons are said to burn 80 hours with out retrimming, and without any blackening or discoloration of the globe. Owing to the high potential at which it is possible to burn the arc in this enclosing chamber, the efficiency of the lamp is greatly increased. The lower part of the carbon frame is in the shape of a ring having diametrical enlargement to admit the arms of a spider-shaped casting, and which is provided with an adjustable movement on the carbon holder. This carbon holder has a porcelain handle and a spring to hold the yielding pan tightly against the

lower opening of the globe. A longitudinal bore in the carbon holder admits the negative carbon, the upper part of the bore being enlarged to form a seat for the small globe. A metal cover, through which the positive carbon loosely feeds, is placed over the mouth of the small globe and acts as a cut-out when the carbon has been burned to a predetermined point.

For the inside lamps a rheostat of enameled iron is provided in shape of a headboard with binding posts, hanging straps and switch complete. An opening in the center of the rheostat permits of securing it to the ceiling by half-inch lag screws. Porcelain insulators, placed over four studs provided for that purpose, may be used to separate the rheostat from contact with the ceiling. When not desirable to secure the rheostat directly to ceiling, the lamp may be suspended from a ring.

## Proposed Canadian Street Railway Association.

According to the *Canadian Electrical News* there has recently been some preliminary discussion looking to the formation of a Canadian Street Railway association, whose objects would be similar to the street railway association in the United States. In view of the rapidly increasing magnitude and importance of the electric street railway interests in Canada some association for the discussion of common difficulties and the promotion of common interests is a natural development. Membership in the American association will meet many of their needs, but in a different country and climate the Canadian railways operate under many conditions in which the American roads have no share or interest. These conditions, however, are not without interest to other classes of electrical enterprise in Canada, and directly or indirectly are shared by them. The street railways have at present a very small representation in the list of members of the Canadian Electrical association, and it seems a great pity that before segregating themselves in a street railway association they should not try whether the existing association will not fill the need they are beginning to feel. Electric street railways really occupy a central position among telegraph, telephone, light and power and manufacturing enterprises. Some of these have apparently very little in common with each other, but all of them come more or less into contact with the street railways. They are all well represented in the Canadian Electrical association, which now needs only an increase in the number of its street railway members to be completely representative of all classes of electrical enterprise in Canada. All electrical interests, however dissimilar at first sight, have much in common. Like it or dislike it, they cannot help reacting upon each other, but it is in their own hands whether they endeavor to make this interdependence a help, or suffer it to become a hindrance, and it is here that the benefit comes in of beginning by a general association whose objects, as stated in the constitution of the Canadian Electrical association, are "to foster and encourage the science of electricity and promote the interests of those engaged in any electrical enterprise, and for the discussion and interchange of opinion among its members." Such an association is an endeavor to modify the natural narrowness which comes to all of us when we each know our own business and are each struggling for our own profit, and when in the obviousness of the points of difference between us and other strugglers we are prone to lose sight of what we have in common, and regard contact as synonomous with conflict. To begin by class associations is to intensify this narrowness. To begin by a general association is to first try what profit we can derive from intercourse and such common action as is possible with those engaged in making a living in kindred occupations. Following on this the subsequent organization of special associations will come naturally as the outgrowth of healthy business development; but their membership, overlapping with that of the general parent association, should preserve them from the unprofitable narrowness of isolation. Whether a street railway association is organized in the near future or not, we trust that the September meeting of the Canadian Electrical association will show a large addition in the list of members interested or employed in electric street railway work.

## Clambake of the American Electrical Works.

The sixteenth annual Rhode Island clam dinner tendered to the electrical fraternity by the American Electrical works of Providence, R. I., will be held at Haute Rieve, Saturday, August 25th. This announcement will be a pleasing one to the members of the fraternity who have learned by past experience to regard this occasion as one of the principal opportunities for a pleasant social meeting of electrical men. In years gone by the hospitality of President Phillips, Secretary Sawyer and Treasurer Hathaway of the American Electrical works has made these annual clambakes memorable excursions, and the preparations already made for this year's meet portend an unusually merry time.

## Electrical Ball Players.

The Western Electric Base Ball club, a majority of the players of which are employes of the Western Electric company, has for two years been considered one of the best amateur teams in the city. Last year, out of 16 games played with the best commercial nines, it won 12; this year, out of 12 games played, it has been victorious in 10. On Saturday afternoon, August 25th, the club is to try its strength against Prof. Stagg's team on the University grounds. Many electrical men will be present, as well as many from the University, and the much discussed question as to the superiority of practical over theoretical electricity will be definitely settled. The teams will line up as follows:

| *Western Electrics.* | | *Chicago University.* |
|---|---|---|
| Kerns | Pitcher | Stagg |
| Stock | Catcher | Pike |
| Kelly | First Base | Winston |
| Meehan | Second Base | Adkinson |
| Lyon | Third Base | Rothschild |
| Parker | Shortstop | Nickols |
| Hanrahoe | Left Field | Brown |
| Snail | Center Field | Bowers |
| McKevitt | Right Field | Spear |

# CORRESPONDENCE.

## New York Notes.

New York, August 20.—A trial was made last Friday of the new four-track electric bridge of the New York, New Haven & Hartford Railroad company over the Bronx river, at West Farms. The bridge is said to be the first structure of the size in the country to be moved by electricity, which will be furnished from the power house of the Union Railway company, which operates the trolley lines in the Twenty-third and Twenty-fourth wards. The bridge is of solid steel, and its cost when completed will be $50,000. In the trial Friday, which was conducted by several officers of the company, a number of the iron cogwheels of the draw broke, necessitating the substitution of new ones. Seven men moved the draw, as it has not yet been connected with the electric apparatus, and the work was very slow. The trial was considered very satisfactory, and in a few weeks will be ready for use. The bridge is one of the first four-track bridges constructed in this state.

The Norwalk, Conn., Tramway company and the Norwalk & South Norwalk Street Railway company are at war. Eighteen months ago, when the Tramway company was putting down its tracks through Wall street, where the street railway tracks also run, there was a disagreement between the two corporations, and the street railway company secured an injunction against the Tramway that caused the latter an expensive delay of several weeks. The Tramway corporation did not forget this, and last Thursday tried for revenge. The railway company's stock has recently changed hands, the road has been double tracked on West avenue, and trolley wires strung on the main line and the Winnipauk branch. Through Wall street the two companies use the same tracks and, of course, the same trolley wires.

The street railway company started Thursday to run electric cars. Each company has its own dynamos at the big power house of the Norwalk & South Norwalk Electric Light company. The question arose as to which should furnish the electricity for the run through Wall street. It was finally arranged that each should furnish the power over the common wires for six months, but which should furnish it for the first six months could not be agreed upon.

Thursday President E. J. Hill of the street railway company telephoned to the Tramway company notifying it that the street railway company had started its electric cars, and that the Tramway company would be expected to furnish power for six months. The Tramway company objected, but its own cars had to run through Wall street. Soon after noon an electrician climbed the pole in front of the Fairfield County National Bank building and went to work to put a cut-off on the heavy feed cables. The Tramway company's cars would come into Wall street, followed by the other company's car. The tramway car would run rapidly up to the Belden avenue corner, where it reaches its own lines. Then the man perched on a barrel in front of the bank building would reach up with a big screw driver and push a lever in the cut-off and the car following it would stop. In a few minutes, when the Tramway car came back, the current would be turned on and the street railway car would go ahead. The street railway officials were puzzled for some time. A street railway employe cut the Winnipauk feed cable, and armed with rubber gloves and two pairs of nippers, brought together on a big block of wood the end of the Winnipauk cable and that of the main line. When the tramway shut off its power in Wall street, he joined the wires to give his company power from the branch wire. The dynamos began to burn out and the whole station was in danger. A temporary amicable arrangement was entered into. W. F. O.

## St. Louis, Mo.

St. Louis, August 18.—The Citizens' railway, a cable road, is being changed to an electric line. At present the road extends from Fourth street westward over Franklin avenue, Morgan street and Easton avenue to King's highway boulevard with a horse car extension to Rinkleville. The ordinance authorizing the change also authorizes an extension of the road to the city limits at Wellston, making a total length of about six and one-half miles of double track. An entirely new equipment of rolling stock consisting of 60 double truck 35 foot motor cars will be put on.

The Southwestern railway, a new road in the southern end of St. Louis, is under construction. This road connects with the Seventh Street electric line and also the Broadway cable line at the corner of Broadway and Chippewa street and extends in a southwesterly direction with double tracks on Chippewa street and Gravois avenue to Morgan Ford road, a distance of about two miles. Through cars will run from this road northwardly over the Seventh street electric line through the central part of town over the Cass Avenue & Fair Grounds railroad as far north as Cass avenue. An additional ordinance authorizes the extension of the Seventh street line a distance of one block on Seventh street, to connect with the Cass Avenue & Fair Grounds road, to provide for through car service. Twenty motor cars will be used and passengers will be transferred to and from the Cass avenue railway and the Broadway cable line. These roads are all controlled by a Chicago syndicate. Power will be supplied from the Cass Avenue & Fair Grounds Railroad company's power house.

The St. Louis Electric Light & Power company is putting in a 200 light Excelsior arc machine of the new pattern, a 110 kilowatt 500 volt generator for power circuits and a 300 horse power Russell four-valve engine.

The Postal Telegraph-cable company is now laying cables in the subway of the St Louis Underground Service company. The work is being done by the Standard Underground Cable company. R. J. H.

## Milwaukee, Wis.

Milwaukee, Wis., August 18.—At the last regular meeting of the Common Council a resolution looking to the purchase by the city of the street railway system and its operation as a municipal enterprise was introduced by Alderman Ranschenberger, the president of the board. The resolution recited that as the property of the Milwaukee Street Railway company had been assessed at $2,800,000, and that as the vice-president of the company had publicly declared that such assessment was largely in excess of the real value of the property, and that as a large portion of the taxpayers of the city believes that the street railway system should be owned and operated by the city, a committee of five members of the Common Council, together with the city comptroller and the city attorney, should be appointed to ascertain if the electric car system, with its adjuncts the electric lighting plants, could be purchased by the city, and if so upon what terms, and that the same committee should report how the money necessary for such an enterprise could be raised by the city.

The committee appointed consists of Aldermen Williams, Thuering, Devos, Ramsey and Renning. A canvass of the city officials shows that most of them appear to be heartily in favor of the proposition. Mayor Koch says that it is only a question of money. If such a transaction can be arranged financially, he states, it ought to be carried out, as it would result beneficially to the city at large. Comptroller Fiebrantz and Deputy Comptroller Wilde both favor the plan. They estimate, however, that as the margin of the bond limit is only about $1,000,000, the plan to buy the street car property outright is not feasible. Moreover, while the city is authorized by law to purchase an electric lighting plant or a gas plant, a special act of the Legislature would be necessary in order to permit it to purchase a street railway system. With such authority, they claim, the city might purchase the property on the installment plan.

Three theories are advanced regarding the action of the Common Council. One is that the council is really acting in good faith and would purchase the street car system if able to make the necessary arrangements. Another theory is that the council is simply getting even with the Milwaukee Street Railway company for its action in regard to the assessment of the railway franchises. The company fought the assessment and is still fighting it, the matter being in the courts at the present time. The assessment, while it is

more than double what it was last year, is still very much below the real value of the property—at any rate the property is bonded for the sum of $13,000,000 in round figures. These facts lend some color to the theory that the Common Council never really expects to aquire the street car lines. The third theory is a political one. It is charged that the Republican aldermen, by making a feint of buying the street railway, hope to get votes from the ranks of the Populists, who are very strongly in favor of municipal ownership of the gas plants and the electric railway and electric lighting systems of the city.

Vice President Payne of the street railway, while he evidently never expected such a step, and will not talk about the matter in public, pretends to make light of it in private.

The Sixth street electric line has been abandoned. The cars ran on Sixth street, North avenue, Third street and around the loop. The track on Sixth street has been torn up.

The time allowed by the Common Council for the street railway company to put concrete under its ties on streets that are being paved with asphalt has expired, and the company has not taken any steps to comply with the order. The matter has been considered by the directors and attorneys of the company, with the result, apparently, of a resolution to defy the city authorities. The company will probably permit the city to do the work, as it has threatened to do in case the company fails to comply with the order, and will afterward oppose any effort of the city to collect payment for the work. Some of the new asphalt pavement in question has already been laid, and it is liable to material damage, according to the city authorities, by reason of the fact that the street car tracks are not solid, but permit the water to get under the top dressing of asphalt.

In the eleventh ward a petition is being circulated asking the street railway company to reconsider its action in withdrawing commutation tickets from sale and urging the company to sell at least 23 tickets for $1. The action of the company hurts the working people of the city much more than it would have done a year ago, and there is much complaint among them. In some places the establishment of bus lines is proposed, and already the Hoffman-Billing company has such a line for the accommodation of its patrons.

The Detroit Electrical Works have sued the Racine Street Railway company and J. I. Case for $20,000 damages, claiming that they were induced to give a very low figure on the Racine equipment on condition that they would get the contract for the Green Bay line, which they did not get. Mr. Jackson has become the sole owner of the Racine system, his former partner taking Mr. Jackson's interest in the Green Bay line. C.

## PERSONAL.

William H. McKinlock, president of the Metropolitan Electric company, has left Chicago for a two weeks' business trip through the West.

A. H. Goode, formerly with the Jenney company, has taken charge of the motor department of the Central Electric company, Chicago.

H. J. Medbery, president of the Fiberite company of Mechanicville, N. Y., manufacturer of the Medbery insulation for street railway supplies, has been spending a few days in Chicago. Mr. Medbery reports a good business in the East.

## ELECTRIC LIGHTING.

Niles, Mich., has purchased the Niles Electric Light company's plant for $37,500. The electrical machinery is to be utilized, in addition to furnishing light, to supply water for a new water system.

It is probable that the electric lighting plant of Rochester, Minn., will soon be enlarged by the addition of a dynamo. No decision as to what type of apparatus will be employed has been made.

The Ottawa Electric Light company, the Standard Electric company and other electrical interests of Ottawa have been combined in the Ottawa Electric company, with headquarters at 72 Sparks street, Ottawa.

The clerk of the city of Middletown, O., will receive bids to light the streets and city buildings with electric lights for the term of five years, commencing November 1, 1894. Bids will be received until August 10, 1894, at 8 o'clock P. M.

An Indian paper states that, following up the trial installations in Colombo, Ceylon, which from all accounts were successful, several hotel proprietors, mill owners and the harbor authorities intend illuminating their premises with electric lights. Proposals are also before the municipality for lighting the whole town of Colombo.

The Chicago city law department has decided that the Commissioner of Public Works has the right to require the railroads to provide any kind of lights that he may see fit at their crossings, and in view of this decision the Rock Island road will be forced to put up electric lights at the crossings as ordered by the commissioner some time ago. When the commissioner ordered the company to place electric lights at several crossings it refused to comply.

The contract for the building of the entire plant of the Kalamazoo, Mich., electric lighting plant, has been awarded to the Commercial Electric Engineering company of Detroit, and application should be made to this company by those who desire to make bids for furnishing any portion of the work. No action has been taken by the city council in regard to the bonds which are to be issued.

## ELECTRIC RAILWAYS.

The Meriden, Conn., Electric Railway company has decided on extensions.

Preparations are being made by the street railway company at Strassburg, Germany, for using electric traction on the lines in the central parts of the town. Arrangements are being made with the Allgemeine Elektricitats-Gesellschaft of Berlin for the supply of motor cars. These will be tried until it has been demonstrated that electric traction is satisfactory.

The authorities at Leipzig, Germany, have given a concession to the Allgemeine Elektricitats-Gesellschaft and R. Lehfeldt of Leipzig for the construction and working of an electric street railway. The new lines will traverse the whole of the inner part of the town, which has hitherto not been served by any road. The system of lines for which the concession has been granted amounts to over twenty-one miles.

The Chicago General Railway company announces that its road on Twenty-second street from Lawndale to the South Side is completed, and that it is now prepared to extend its road on any improved street on the North or West Divisions of Chicago, where property owners will sign frontage and secure the consent of the city council. The company will agree to construct such extension immediately after passage of the ordinances; to sell six tickets for 25 cents; to equip the lines with fine electric cars; to issue transfer tickets at all points agreed upon with the mayor, and to pay to owners of property the cost of paving 16 feet on all streets improved within one year. The company, it is said, is anxious to build a line from Twenty-second street to the vicinity of Union Park and thence to Lincoln Park without passing through the down-town streets, all for a single fare, instead of two as now required.

The electric companies operating south of Thirty-ninth street, Chicago, have had before the Commissioner of Public Works for three months an agreement they wish to enter into with the city, which, it is said, forever would shut out competition in the district mentioned by the clever wording of one of the clauses. By this no company which hereafter secures a franchise can operate in the district without first agreeing to do so through underground conduits. This would serve to shut out any company not in the agreement now pending from stringing electric wires on poles. The agreement was referred to Supt. McCarthy of the Bureau of Streets and Alleys. It has rested on the desk of the latter awaiting the approval of the corporation counsel. Mayor Hopkins was shown a copy of the clause. He said: "I am sure no such agreement will be signed by me or others representing the city. In the first place it would amount to nothing if we did, as it is something that must come within the province of the council, and the mayor cannot sign away rights of the council or make any contract for that body. It would in no sense be binding on the city, and for that reason alone would not be entered into."

Since March, Hamburg, Germany, has had an electric overhead trolley road, says a contemporary. The current is furnished by the municipal electric central station, the equipment of which was increased for this purpose by a 100 kilowatt Thomson-Houston generator, working at a voltage of between 500 and 550. The feed wires, consisting of two heavily insulated copper cables, protected by double lead sheathing and a sheet metal armor on the outside, are buried below the street level, at depths of from 18 to about 40 inches. Connections with the trolley wire is made at three different points, at which also there are current indicators and cut-outs. The return is a bare copper wire, laid directly in the earth. The trolley wire itself is not continuous, but is made up of sections about 500 meters, or 1,640 feet long, terminating in insulated points. Connection between these sections is made by cut-outs, so that, ordinarily, there is a continuous circuit from end to end. Any one of the 500-meter sections can be at once deadened, if need be, however, as in the case of a fire along the line. In addition to the bare copper underground return wire already mentioned, the rails are connected at their joints, in the customary way, by soft, tinned copper wire. At about every 300 feet there is, moreover, a cross connection of the opposite rails by two copper wires, and at about every 1,600 feet the connecting wires are attached to ground plates buried below the ground water line.

The *Railroad Gazette* says that excavations are now being made at Baltimore, Md., for the power-house to be used in operating the Belt railroad. It will be a one-story brick building. It will have a front of 339 feet on Howard street, 69 feet on Henrietta street, and 58 feet on Montgomery street. The boiler-room will be 98 feet long and 69 feet wide, and will be fitted with automatic conveyors for coal. The machinery room will be 240 feet long and 58 feet wide. The equipment of the building will include 11 250 horse power boilers, with a 50 foot smokestack and mechanical draught. The engine-room will contain four 750 horse power Corliss compound engines directly coupled to four 700 horse power multipolar generators, which will furnish the electric power for locomotives and also for lighting the tunnel. In addition there will be four 250 horse power Armington & Sims compound engines, two of which will drive eight 50 arc light machines, each light having 2,000 candle power. These lights will be used at Mount Clare, Locust Point and Camden Station. Each of the remaining two engines will be used to drive two generators capable of lighting 2,000 16 candle power incandescent lamps for use in the new depot at Bolton lot and other places along the line. Provision will also be made for an extra 700 horse power generator. It is said that the motive power for the tunnel trains will consist of three locomotives having two trucks each, each truck to be equipped with two 300 horse power electric motors. The power house was designed by Baldwin & Pennington. The electrical equipment was designed by the General Electric company, and is being made at the company's shops at Schenectady, N. Y.

## ELECTRIC MINING.

The Wellington Coal company, Nanaimo, B. C., has given an order to the Royal Electric company, Montreal, for an electric mining locomotive to be used in the company's mines.

Electric machinery, it is said, is to be used in the operation of the Silver Lake mines in Colorado. The mines are located upon a mountain side, and the use of steam was considered impracticable. It is intended to generate electricity at the foot of the mountains by utilizing the waterfalls and putting in dynamos. The current will be carried up the mountains to motors located at the mines.

The advantages of the use of electrical power are beginning to be appreciated in the iron mining region of Michigan. The Cleveland Iron Mining company has just contracted for a locomotive haulage plant from the Chicago office of the General Electric company. Two 30 horse power locomotives will be operated in the galleries of the mine at first, supplied by a dynamo of sufficient generating capacity at 220 volts. The conductors are incased in lead covered cables and led down the shaft.

## TELEPHONE.

The Bement, Ill., Electric Light & Power company has increased its capital stock to $10,000 and elected the following officers: President, C. F. Lenney, secretary and manager, W. J. Day. The company intends to install a telephone exchange.

The United Telegraph & Telephone & Electric company, with a capital stock of $1,000,000, has been incorporated by Donald McDonald, John G. Earle and Edward P. McConnell, to construct and maintain a telegraph, telephone and electric business. The company proposes to confine its operations entirely to Hyde Park, Chicago, and Mr. McConnell says it has ample backing. It is intimated that the company may be combined with the Chicago Harrison Telephone company. The United company contemplates purchasing, or has already purchased, the 50 miles of wire lines, with poles, etc., already erected in Hyde Park by the Postal Telegraph company. The lease held by the Postal company will soon expire, and then the Postal will place its wires underground.

## TELEGRAPH.

The Western Union Telegraph company has commenced a suit against the Des Moines Northern & Western Railway company and the Postal Telegraph Cable company on a contract in regard to the use and operation of a telegraph line on the right of way of the defendat railroad company. The plaintiff claims to have a contract giving it the exclusive right to operate such a line, and alleging that the railroad company violated the contract and allowed the defendant Postal company to remove the Western Union instruments and place its own in their place and make connection with Western Union wires. The Western Union company asks for a restraining order, admitting its inability at this time to estimate its financial loss.

The Electrical Subway Commission of Baltimore has approved the specifications of Engineer Hill for putting part of the wires of the fire-alarm telegraph system underground. Bids will be invited for different kinds of conduits, and the commission will decide afterward upon the kind of conduits to be used. Creosoted wood, iron, terra cotta and concrete conduits may be used. An appropriation of $100,000 was made by the City Council for this work. All the wires in the city fire alarm system cannot be put underground for this amount, so it was decided to use the conduits of the Chesapeake & Potomac Telephone company where possible and build supplementary conduits where necessary. By this method it is expected to protect the wires in the center of the city, and wires leading to all engine and truckhouses excepting those on the outskirts.

The North American Telegraph & Telephone company of Oswego, N. Y., was recently incorporated at Albany, with a capital stock of $25,000. The incorporation authorizes the company to construct and operate telegraph and telephone lines from Brockport, Can., to Alexandria Bay and Oswego, in New York state, and intermediate points about the Thousand Islands. Work upon the new line will commence immediately and as much of the line as possible be constructed before snow falls. The line will be started and run to a point opposite Alexandria Bay. There a cable will be laid over to the bay on the United States side, thence the line will be extended to Oswego. Lines will be run to New York and connections made with the principal cities throughout the state. The general headquarters of the company will be at Deseronto, Ont., and the United States headquarters in Oswego.

## LEGAL DECISIONS.

Where a telephone company, invested with the power of eminent domain and authorized by law to erect poles and stretch wires through the streets of a city, was required by ordinance to move its poles and wires from a street to the adjoining sidewalk, it was necessary, holds the Circuit Court of Appeals in the case of the Southern Bell Telephone & Telegraph company against Constantine, in com

plying with such ordinance, to trim certain trees, which was done by the servants of the company under the direction of a city officer. The company was not liable to an action of trespass by the owner of the trees, since the act was done under lawful authority.

The Court of Chancery of New Jersey questions, in the case of the West Jersey Railroad company against the Camden, Gloucester & Woodbury Railway company whether there may not be methods of operating an electric railway resorted to which will be within the objection that it constitutes an additional servitude for which compensation must be made. And it also questions whether serious injury to improvements which the abutting land owner may make upon and under sidewalks by the planting of poles to support the overhead wires will not be within like objection. But it decides positively that a street railway, constructed in a highway under authority of law, with a roadbed which will admit of the free use of the highway by all other lawful means, operated by cars patterned after the style and size of cars ordinarily in use by horse railways, the motive power of which is electricity, supplied by means of overhead wires supported by poles planted in the sidewalks immediately within the curbs, is but a modification of the public use to which the highway was originally devoted, and is not an additional burden on the land for which compensation may be required. Equity, it says, will not enjoin an unauthorized obstruction in a public highway at the instance of a private person, corporate or natural, who does not suffer some special damage from it differing in kind from the damage which such person sustains as a member or the community; and, within this rule, a railroad company, though it does public service, stands substantially upon the footing of a private individual. Such special damage is not suffered by a steam railway company which has merely the right to operate its road across the highway at grade, through the establishment in the highway of a street railway, the motive power of which is electricity, supplied by means of wires elevated a sufficient height to admit the free passage of the cars of the steam road thereunder.

## TRADE NEWS.

The Fort Wayne Electric Corporation, Fort Wayne, Ind., has closed contracts for complete electric light plants for the villages of Lapeer, Mich., Clear Lake, Ia., Canandaigua, N. Y., and Carthington, O.

The Simplex Electrical company has been awarded the contract for the wire for 3,000 incandescent lights in the new Castle Square theater and hotel in Boston. The Chicago office of this company is at 1137 Monadnock building, with H. R. Hixon in charge.

The Correspondence School of Technology, Cleveland, O., has engaged J. N. Dodd, a graduate of Princeton and last year fellow in mathematics at Princeton, as instructor in mathematics. The school reports considerable growth and also has received letters from its students commending the work.

C. J. Blandin, manager of the Minneapolis office of the Watertown Steam Engine company, has secured a contract for the power plant of the Delano Electric Light & Power company, Delano, Minn. The Watertown Steam Engine company is also just completing the extensive power plant of the Whiting Foundry Equipment company at Harvey, Ill. It has just equipped the Woolner Distilling company of Peoria, Ill., with one 250 horse power slow speed automatic engine, one 125 horse power slow speed automatic engine and one 70 horse power high speed automatic engine.

Catalogue No. 67 of the Westinghouse Electric & Manufacturing company, Pittsburg, Pa., treats of multipolar generators and motors manufactured by the company in sizes from ¾ of a horse power up. A detailed description of the apparatus is given together with illustrations. Several important tables help to make the book an interesting one.

The Metropolitan Electric company, Chicago, received some good-sized orders for I. N. L. triple braid wire during the last week, among the number being one for 13 miles and one for 10 miles, large sizes. This wire is coming into prominent notice in the West, being already a favorite in the East, and the Metropolitan Electric company carries a large supply always on hand to enable it to fill orders without delay.

The Mather Electric company, Manchester, Conn., reports the shipment last week of a carload of electrical apparatus, consisting of one 250 light dynamo and ten 5 horse power Manchester type slow speed motors, with special starting boxes, to the Massachusetts State Insane Asylum at Danvers; the motors will be used for operating ventilating fans throughout the buildings; the whole installation being in the hands of G. M. Angier & Co. of Boston, New England contractors for Mather apparatus.

One of the handsomest of recent electrical catalogues is that issued by the Western Electric company. Its 100 sumptuous pages describe and illustrate nothing but the company's own manufactures, which comprise arc and incandescent machinery, power generators, motors, arc lamps and fixtures, measuring instruments, batteries, switchboards, rheostats, lightning arresters, lamp posts, and many other supplies, including apparatus for theatrical lighting effects. The lithographed cover of the catalogue deserves a particular word of praise for its artistic design and harmonious colors.

## BUSINESS.

J. C. Woodward, San Francisco, Cal., has sold a 100 light Excelsior arc dynamo to the Oakland Gaslight & Heat company.

The New York Insulated Wire company reports that Grimshaw white core wire is being used extensively for marble switchboard work in Chicago.

Wm. H. Bryan and Winthrop Bartlett, mechanical and electrical engineers, Turner building, St. Louis, are engaged on plans for the Howard street loop of the Southern railroad.

The Metropolitan Electric company, Chicago, is having considerable call for the Kester commutator compound, station engineers finding it to be just what is needed in the preservation of the commutator and prevention of sparking.

Meissner's rheostat and stage dimmer, manufactured by the Washington Electric company, 207 South Canal street, Chicago, has received some very flattering testimonials from plants where it has been installed. The company has received a number of orders for this article during the last week.

The National Electric company has recently sold dynamo machinery as follows: Frederickstown, Mo., 500 lights (alternating); Caldwell, Cal., 500 lights and 18 arc lamps (alternating); Chicago Beach Hotel, 500 lights (direct current); Leland Hotel, Chicago, 1,600 lights (direct current); Leland Hotel, Springfield, Ill., 500 lights (direct current); *Register* office, Springfield, Ill., 100 lights (direct current); Medinah Temple, Chicago, 1,400 lights (direct current.)

S. W. Rushmore, 126 Liberty street, New York, has increased his facilities for the manufacture of his high tension arc lamps by the addition of several special and expensive machines. He has discontinued the manufacture of the constant potential arc lamps, having sold his patent rights to the General Incandescent Arc Light company.

The Electric Appliance company, Chicago, has been experiencing a very satisfactory trade during the month on its two wire specialties, Paranite rubber covered for inside work and O. K. weatherproof for line work. Numerous large orders have been received. Coming as they do so early in the season promises well for a satisfactory fall trade.

Since the fire on August 1st, which destroyed the factory of the Siemens & Halske Electric company of America the company has closed six contracts for various classes of machinery, of which the two most important are one at the Hotel Savoy, New York, for a large lighting plant and one with Franklin MacVeagh & Co. in Chicago, for an electric power transmission plant.

The Mather Electric company, Manchester, Conn., reports the sale, through Harry S. Smith & Co. of Philadelphia, of two 45 kilowatt directly connected dynamos for the Bartram apartments of that city. These dynamos are to be of the new Mather multipolar type, directly connected to Woodbury engines, and when completed will be one of the finest directly connected plants in Philadelphia.

Napoleon, O., has just closed a contract for a complete pumping and electric lighting station. Not less than 110 bids were submitted and considered for various parts of this work. The power plant, consisting of two compound condensing engines of 100 horse power capacity each and two 100 horse power boilers, was awarded to the Watertown Steam Engine company through G. N. Crawford, the company's Chicago agent.

The Chicago office of the Ball Engine company, Erie, Pa., in the Rookery building, reports a fair amount of business. Among recent sales are the following: Peninsula Electric Light & Power company, Houghton, Mich., one 350 horse power tandem compound engine; Hotel Newcombe, Quincy, Ill., one 60 horse power engine; Howe Pump & Engine company, Ladd, Ill., one 50 horse power engine; Industrial Home of the Blind, Chicago, one 80 horse power engine directly connected to a General Electric dynamo; Norton Bros., Maywood, Ill., two 150 horse power cross compound engines.

The Gilliland Telephone company of Chicago is meeting with good success in the introduction of its telephone. The instrument is made in a substantial manner and is artistic in form, consisting of a magneto mounted on a backboard with desk, a bi-polar magneto transmitter, and a telephone receiver with cord. The company's central office and exchange system for towns and small cities is complete and comprehensive. The president, William H. McKinlock, and the general manager, J. J. Nate, have spent the greater portion of their lives in telephone and kindred electrical interests, securing therefrom a broad and valuable experience, which are very necessary factors to the advancement of telephone work, and doubtless, with the apparatus which this company is handling, and the vast opportunities for work in the telephone field, a successful future is assured.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued August* 14, 1894.

524,305. Arc Lamp Post. Richard R. Bowker, New York, N. Y. Application filed June 22, 1894.

The object of the invention is to provide a novel and convenient disposition of arc lamps for city lighting, which may be employed in connection with the ordinary incandescent lamp mains, and which requires no special wire between the supports, either overhead or underground.

524,343. Electrical Conductor. Edwin D. McCracken, Alpine, N. J. Application filed November 29, 1893.

An electrical conductor is described, having a covering consisting of a strip or strips of paper, composed of pure vegetable fiber, applied in its unchanged fibrous condition, the paper forming of itself an insulating covering and having a suitable material coating and permeating it to render it practically anhydrous.

524,357. Electric Arc Lamp. Otto H. Swoboda, New York, N. Y. Application filed July 19, 1893.

In an arc lamp a shunt around the arc in combination with the carbon feeding mechanism is provided.

524,361. Method of and Apparatus for Detecting and Measuring Inflammable Gases. Benjamin C. Tilghman, Jr., Philadelphia, Pa. Application filed March 14, 1893.

This invention relates to an improvement in the method of and apparatus for detecting the presence and measuring the amount of inflammable gases or vapors contained in the air of mines, oil tanks and similar places where such gases are apt to occur.

524,366. Electric Railway System. Theodore B. Wilcox and Henry Wilcox, Newark N. J. Application filed August 1, 1893.

This invention relates to improvements in certain details of an electric railway system previously patented by the inventors, and has particular reference to the surface plates of this system.

524,367. Electro-magnetic Contact-making Device for Electric Railway Systems. Theodore B. Wilcox and Henry Wilcox, Newark, N. J. Application filed August 1, 1893.

This patent refers to the same system as the preceding patent, and has particular reference to the details of the magnet and magnet box.

524,368. Electric Railway System. Theodore B. Wilcox and Henry Wilcox, Newark, N. J. Application filed August 16, 1892.

It is the object of the invention to do away with dangers from leakage, etc., as appertains to systems of street railway propulsion in which a large number of electro-magnetic appliances are maintained underground along the railway track.

524,373. Regulation for Dynamo-electric Machinery. Edward M. Bentley, Boston, Mass. Application filed December 26, 1890.

This device, shown in diagram in the accompanying illustration, is more particularly intended for use in conjunction with dynamo-electric machinery employed to furnish motive power on a constant potential circuit. *A* represents the commutator of a dynamo-electric machine, which has a series of segments understood to be connected in the usual manner to corresponding coils of the armature. Upon this commutator are placed three constact brushes, one of the three, *B*, being the negative brush, and the other two, *C* and *D*, placed normally at a point on the commutator diametrically opposite the brush *B*, and connected to the same line conductor and constituting duplicate positive contacts. It will be understood that with the two brushes *C* and *D* in the position shown by the full lines, the machine will be giving its maximum electromotive force, and as a motor (the impressed electromotive force being constant) the speed of the motor will be at a minimum. Starting with this arrangement the electromotive force is regulated by moving the two brushes *C* and *D* simultaneously and equally in opposite directions from their normal position as indicated by the dotted lines, until a sufficient number of the armature coils are removed from the series or rendered inactive, and the electromotive force reduced to any desired degree. This will cause the machine when used as a motor to increase its speed until a maximum is reached.

524,374. Battery Changer for Electric Circuits. Charles Bernhardt, Chicago, Ill. Application filed November 23, 1891.

The invention relates to improvements in battery changers for electric circuits, the special use for which it is designed being in combination with a fire alarm system, and its object in that system being to bring into the fire alarm circuit a fresh battery at the moment when certain parts of the system come into operation, and at the same time to cut out of the circuit the battery which ordinarily forms a part thereof.

524,376. Compounding Motor Generators. James Burke, Schenectady, N. Y. Application filed June 5, 1894.

A smaller machine is used in connection with the generator, by which the compounding is effected. This machine may have its armature mounted on the same shaft or otherwise connected with the other machine, which it is designed to compound, and is also connected electrically with it. The main machine may be run, if desired, without the compounding machine, and may therefore be a machine of standard pattern, the only changes necessary to fit it for the modified use being changes in the connection of the machine and the line circuits, these changes being made in combination with the auxiliary machine.

524,378. System of Electrical Distribution. Thomas A. Edison, Llewellyn Park, N. J. Application filed December 6, 1886.

The object is to provide a system in which the greatest economy in the amount of metal required for conductors will be attained, by combining the advantages in this respect of the three-wire system with those arising from the use of currents of high tension reduced at the places supplied, by induction coils or converters, to that required for the translating devices.

524,381. System of Power Distribution and Regulation. John W. Gibboney, Lynn, Mass. Application filed October 21, 1893.

The invention consists in installing in each of a number of mills, manufactories, or the like, a dynamo-electric machine connected to a common circuit, which machine, in accordance with the conditions of load, becomes a generator delivering electric current to drive the other machines, or a motor receiving current from the other machines, whereby the mills or manufactories, so far as their power is concerned, are inter-dependent.

524,382. Rheostat. Albert B. Herrick, Schenectady, N. Y. Application filed May 22, 1893.

A fire-proof rheostat of ample capacity, not subject to disarrangement by jolting or vibration and from which the heat generated by the coils may be easily carried off, is described. The invention also consists of a special arrangement of a fuse, which limits the amount of heat which may be generated in the box, and of certain details of construction.

524,383. Bus Bar Switch for Central Stations. Albert B. Herrick, Schenectady, N. Y. Application filed June 9, 1894.

The invention relates to means for switching heavy currents in central stations where multiplicity of dynamos are operated, and the currents are carried to bus-bars in any usual or convenient manner. One of the principal objects of the invention is to lessen the cost of copper in the systems usually employed at present.

524,384. Double Throw Snap Switch. Edward M. Hewlett, Schenectady, N. Y. Application filed July 2, 1894.

The switch is constructed of three copper blades hinged together at one end and with a spring extending between the two outer blades, a handle being attached to the middle blade. The middle or inner blade is rigid, with a central piece, to which the outer blades are hinged, the inner ends of the hinged outer blades being cut away so that the inner blade may be rotated about its center to a certain angle before it will engage with the cut-away ends of the outer blades to throw them from the contacts.

524,385. Controller for Electric Motors. Joseph H. Jenkins, Lynn, Mass. Application filed February 3, 1894.

The invention comprises a circuit-controlling switch preferably cylindrical in form, a reversing switch co-operating with it, a removable actuator common to both, locking devices preventing the removal of the actuator except at a certain predetermined position of the circuit-controlling switch, and also for preventing any movement thereof when the actuator is detached, and means for removing the circuit-controlling switch and thereby rendering the other parts of the apparatus, as well as the switch itself, accessible without the necessity of removing the other parts from their fixed position in the assembled apparatus.

524,387. Telephone Switch. Harry T. Johnson, Elizabeth, N. J. Application filed February 1, 1894.

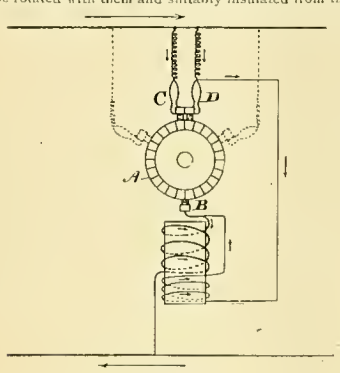
The object of the invention is the provision of means, actuated automatically by a circuit-closing device, to maintain a circuit through the signaling apparatus when the telephone is not in use, and to open the circuit through the signaling apparatus when the circuit-closing device or switch is moved. A further object is the provision of means also actuated by the movement of a circuit-closing device to open and close the telephone circuit.

524,388. Electric Searchlight. Edward R. Knowles, Middletown, Conn. Application filed January 9, 1893.

The invention is an improvement on a former patent and consists in rendering the mirror or reflector readily removable from the drum, in providing an electric motor to operate the diverging lens, and in certain details of the gearing, pedestal doors and electric contact devices.

524,396. Controller for Electric Motors. William B. Potter, Lynn, Mass. Application filed December 21, 1893.

The controller consists in general of a switch of the cylinder type, the rotation of which produces various combinations of the circuits terminating at the switch. The circuit terminals consist of a series of stationary contact springs placed in a line parallel with the axis of the cylinder and bearing upon suitable contact rings or plates, which are fastened to the cylinder so as to be rotated with them and suitably insulated from them.




NO. 524,373.

524,407. Electric Motor. William L. Silvey, Dayton, O. Application filed March 2, 1894.

In association with stationary field magnet rings, the sides of which are substantially parallel, is employed a magnetized armature of annular form, which rotates between two field magnet rings in the plane of its own curvature about an axis coincident with the bisecting line of the field magnets and armature, the plane being at right angles to a circular line passing through the field magnet core intersecting its poles.

524,426. Electro-magnetic Motor. Nikola Tesla, New York, N. Y. Application filed October 20, 1888.

Fig 1 is a diagrammatic view of a motor constructed according to the invention and connected to a generator. Fig. 2 is an end view of a modified form of the armature of the motor. On a shaft is mounted an armature C, which may be a soft iron plate or disk with two cut-away portions or a bar with rounded ends. Around this armature are placed four poles, *D D E E*, of soft iron, and built up of insulated plates or sections to prevent heating. Each of these cores is surrounded by an energizing coil *F*, and all of these coils are connected to the main circuit from the generator in series, or in any other manner, to receive simultaneously the current impulses delivered by the generator. To secure rotation the cores *D D* are made short with their coils close to their inner ends and the cores *E E* long, with their coils removed from the inner ends. By this means a difference in the magnetic phases is secured, which the poles exhibit, for, while the short cores will respond to the magnetizing effect of an alternation or impulse of current in the coils in a certain time, a greater interval of time will elapse before the same magnetic intensity will be developed at the ends of the longer cores, and in practice it has been found that this difference in phase may be utilized to produce the rotation of the armature, the effect being virtually to produce a shifting of the points of maximum magnetic effect similar to that which takes place when two alternating energizing currents differing in phase are used, as explained in previous patents. The essential difference is that in this system the rotation is effected by a time difference of electrical phase, while in the present case it is due to a difference in magnetic phases.

524,462. Arc Lamp. Robert Drysdale, Everett, Mass. Application filed January 14, 1893.

The invention relates most particularly to the mechanism by means of which the carbons are maintained at a proper distance apart while the lamp is in use.

524,467. Insulating Turnbuckle. Henry H. Luscomb, Hartford, Conn. Application filed June 5, 1894.

It is intended to provide an improvement in insulators, and the patent relates to that class of insulators which are termed strain insulators, and which are provided with a turnbuckle device, comprising a screw bolt and a revoluble socket for it, by means of which the slack in the wire or other flexible support for the insulator may be taken up.

524,480. Telephonic System. Henry A. Chase, Boston, Mass. Application filed April 16, 1894.

The transmitting apparatus which, in accordance with this invention, has co-operating with it a device controlling the accessibility to the mouthpiece or opening of the transmitter, and operatively connected to a circuit controller governing the circuit of the transmitter is novel, the device, for the best results, being operatively connected to a second circuit controller, which may and preferably will govern the circuit of the calling or signaling device, which may be the usual magneto now commonly employed in telephone systems, but which second circuit controller may govern the circuit of any desired form of signaling or calling instrument.

524,524. Telephone Transmitter and Resistance Varying Material Therefor. Frank R. Colvin, New York, N. Y. Application filed October 10, 1893.

In carrying out this invention the inventor makes use of a peculiar form of carbon, which is claimed to be free from many of the objections inherent in the forms of carbon which have been in general use for telephonic purposes.

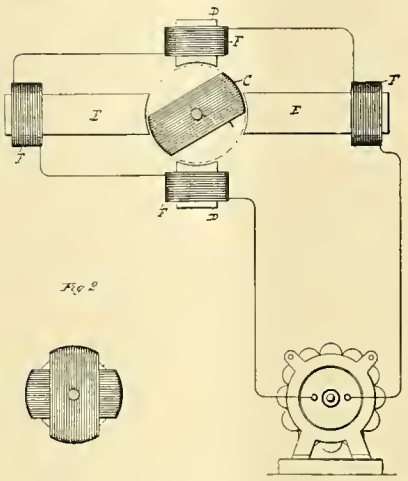



Fig 2

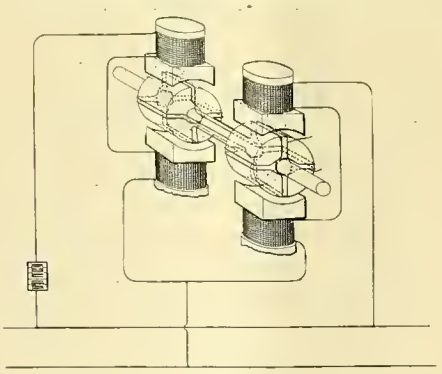
NO. 524,426.

524,533. Dynamo-electric Machine or Electric Motor. Alonzo B. See and Walter L. Tyler, Brooklyn, N. Y. Application filed May 10, 1894.

A cast iron or steel frame or box open at the top and designed to receive a movable cover, two opposite vertical sides of the box being provided with cores for the field magnet coils, is provided. The box is also provided with an integral journal bearing, standard or support. The vertical walls of the box and the standard or support and the cores of the field magnet may all be bored at one operation, and the armature shaft is supported in bearings mounted upon the standard and one wall of the box. The brushes are supported upon and insulated from an elastically yielding arm in such a way as to prevent chattering, and current is led to the brush by a flexible cable provided with a reliable conducting joint.

524,534. Alternate Current Motor. William Stanley, Jr., Pittsfield, Mass. Application filed April 13, 1892.

The motor, as seen in the illustration, is one involving the use of independent fields or sets of poles, and corresponding armatures connected and combined in permanent relations to each other in such manner that the magnetic effect of each field in turn shall induce in one portion of its armature coils the current that imparts the magnetism or magnetic poles to the other armature that co-acts with the field in which such armature is placed in producing rotation. In the preferred form of motor which the inventor has devised for this purpose he employs two



NO. 524,534.

sets of field magnets, having their poles in alignment with one another, which field magnets are adapted to set up fields of force independent of each other, in the sense that their effect is manifested in different planes, and these fields are energized by a source or sources of alternating current in such manner that the magnetic phases of the two fields will be displaced with reference to one another. Within the influence of these fields two armatures are mounted, preferably on the same shaft and in fixed relations to each other, and which are wound respectively with coils. The coils of one armature are connected in closed series with those coils of the other which have a given angular displacement relatively to them.

524,541. Pneumatic Controller. Edward H. Dewson, Jr., Lynn, Mass. Application filed April 11, 1893.

The apparatus described is applied to a switch for controlling electric locomotives having a plurality of motors, by changing the connections of the several motors through various steps from series to parallel and introducing resistance into the circuit at each change of connections to prevent arcing.

524,542. Pneumatic Controller. Edward H. Dewson, Jr., Lynn, Mass. Application filed July 13, 1893.

The invention relates to a pneumatic device for operating mechanism such as a rheostat, switch, or other controller for electric motors where it is essential to actuate the mechanism in either direction with rapidity and accuracy. It is especially designed for use in connection with series parallel controllers for electric locomotives.

524,548. Automatic Electric Signaling Device. Edward A. Hermann, St. Louis, Mo. Application filed April 16, 1894.

This invention relates to improvements on a former patent (5.8,525) issued to the same inventor.

524,615. Motor Regulator. Joseph F. Sheahan, New York, N. Y. Application filed May 28, 1894.

The motor described is designed to be used in operating organ bellows. The object of the invention is to do away with the second rheostat usually employed, and to provide an extremely simple means by which the motor regulating rheostat may be operated from the organ loft or any convenient place, also to dispense with the customary switch and provide means for switching the necessary current to the field of the motor before the current is sent through the rheostat and to the armature, so as to start the motor; to provide means for preventing the too sudden movement of the switch rod and the too sudden starting of the motor, and, in a general way, to produce the simplest possible means for perfectly regulating the motor and causing it to run so as to keep the bellows properly filled.

524,630. Automatic Circuit Breaker. Anatole C. Carles, Portland, Me. Application filed April 14, 1894.

The invention comprises a supporting case, a bridge of some good conducting material, a carrier pivotally mounted in the case, a circuit-breaking rod mounted in the carrier and insulated from it, and adapted to have one end attached to an electric wire and the other end held in contact with the bridge when the wire is strung, the contact end of the rod having a pivoted plate attached thereto and adapted to rest upon the bridge when the wire is strung.

524,635. Telegraphic Transmitter. Frank F. Howe, Marietta, O. Application filed January 15, 1894.

The object of the invention is to provide an improved transmitter which may be operated by persons not versed in telegraphy.

524,636. Induction Coil. Charles L. Jaeger, Maywood, N. J. Application filed January 18, 1894.

The invention provides means whereby the action of an induction coil continues in case the operation of the primary source of electricity is suspended, and causes a signal to be given should the contact breaker of the coil cease to properly perform its function.

524,646. Electric Heater. Charles H. Newbury, St. Paul, Minn. Application filed April 19, 1894.

The special object of the invention is to provide simple and novel means for supporting and insulating the incandescing

Fig. 1

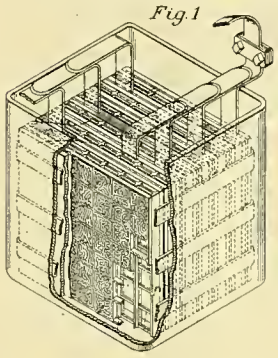
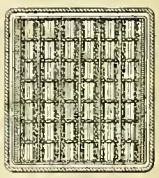


Fig. 2



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filament or wire arranged within the casing of the heater, to simplify the construction and reduce the cost of the supporting devices, and to enable the wires to be positively secured thereby without twisting or bending them.

524,656. Electrical Storage Battery. Burton C. Van Emon, San Francisco, Cal. Application filed November 6, 1893.

The improvements claimed consist in protecting the plates or electrodes from direct contact with the electrolyte or liquid solution, and in so disposing and mounting the active material in sections, cubes or otherwise, that the action of the electrolyte or liquid solution in which the plates are immersed must pass through and not around the active material, and so that the surfaces of contact between the electrode and the active material, as well as between the latter and the retaining grid or agent, will be protected from and impervious to the electrolyte. The object of the invention is to cause the action in charging and in discharging the battery to pass through a uniform stratum of the active material, by protecting the inner face and also the edges of the sections of active material from the electrolyte, and also in providing for expansion and contraction by means of an elastic indestructible confining grid, preferably made of partially vulcanized India rubber, compressed and fitting closely on the surface and edges of the electrodes or plates, and around the edges of the sections or cubes of the active material, thus protecting the electrodes from sulphating action of the electrolyte, except as such action passes through the active material, thereby adding endurance to the positive electrodes and avoiding renewal. Fig. 1 is an elevation and Fig. 2 is a horizontal section.

524,659. Insulator. George H. Winslow, Pittsburg, Pa. Application filed December 8, 1893

One of the objects of the invention is to provide an insulator having means for preventing the formation of a continuous conducting film of moisture between the point of attachment of the conductor and the point of support of the insulator, which may be easily put together, and shall be capable of ready separation of parts for the purpose of cleaning and renovation.

524,672. Trolley Wire Switch. Johan M. Andersen, Boston, Mass. Application filed April 26, 1894.

This invention relates to a novel support for electrical conductors or wires, and may be embodied in a frog, switch or turn-out for the trolley wire.

524,684. Insulating Turnbuckle. Louis McCarthy, Boston, Mass. Application filed June 13, 1894.

An insulator comprising two shells having oppositely projecting connections placed within them and insulated from them, a turnbuckle device having its opposite ends placed within the respective shells and insulated from each of the connections by an interposed mass of insulating material, is described.

# Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, SEPTEMBER 1, 1894. No. 9


## Hon. George B. Shaw.

At 8:15 A. M. on August 27th occurred the death of George B. Shaw, congressman from the Eau Claire, Wis., district and widely known to the electrical fraternity through his former connection with the National Electric Manufacturing company. In the performance of his duties at Washington Mr. Shaw was attacked with what the physicians considered to be malarial fever. He was removed to his home in Eau Claire, where he rapidly grew worse, the symptoms indicating a complication with typhoid pneumonia. Mr. Shaws's condition fluctuated, and reports from his bedside excited alternating hopes and fears, until, on Monday morning, came the sad news that he was dead.

George B. Shaw, whose portrait is herewith given, was still a young man, and, until the time of his fatal illness, his personal appearance was characterized by every indicatiou of abounding vitality and robust health. His death in the prime of life is particularly depressing and will cause widespread sorrow.

The deceased congressman was a native of Alma, Allegheny county, N. Y., and was born on March 12, 1854. He received a public school education and early entered commercial life. Removing to Eau Claire, he engaged in the lumber business, and established a large factory for the production of builders' materials, sash, doors and blinds, as well as becoming connected with several other manufacturing concerns of that city, chief among which was the National Electric Manufacturing company, which he served in the capacity of manager from 1889 to 1892. Under his active and aggressive policy that company soon became one of the leading electrical concerns of the country. Mr. Shaw spent a large portion of the World's Fair year in Chicago, and became a familiar figure in the electricity building, as he had charge of the entertainment club for the visiting customers of the Ansonia Electric company. After that time the deceased devoted himself to his public duties.

In politics Mr. Shaw was a staunch Republican and served his party as a delegate to the Chicago convention of 1884, enthusiastically supporting all the measures proposed for the administration of the federal government on the lines of Republican policy. For the next four years he was actively interested in the politics of the community in which he lived, so far gaining the esteem of his fellow citizens as to be elected mayor of Eau Claire, serving one term, 1888–1889. He was elected to the Fifty-third Congress for the Seventh District of Wisconsin over three opponents, and it was at Washington that his system received the germs of the disease which cost him his life. Mr. Shaw was an enthusiastic fraternity man, and in July, 1890, the insignia and authority of the rank of supreme chancellor for the world, Knights of Pythias, were bestowed upon him. This position he held until August, 1892, being the highest honor that can be obtained in that fraternity.

Possessing a clear, logical understanding, oratorical gifts of no mean order, an unusual degree of urbanity and that attractive quality known as personal magnetism, Mr. Shaw was well fitted to obtain success in public life. Had he lived, greater distinction than any he had attained would undoubtedly have been his. His electrical friends feel a genuine and deep sorrow at his untimely demise and extend heartfelt sympathy to the widow and two children who survive him.

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Judge Scales of Chicago has entered an order allowing the assignee of the Co-operative Electric Light company to sell the plant of the insolvent concern to the Chicago Edison company for $45,000. The plant is on North State street. The company assigned on July 13th to Jacob W. Richards as assignee.

## Minnesota "Vestibule Law" Held to be Constitutional.

Electric railway men have been greatly interested in the laws recently passed in Minnesota and other northern states compelling the railway companies to erect vestibules on motor cars to protect the motormen from the weather during the winter months. The Minnesota law, in particular, requires of street railway companies operating electric, cable or steam cars, requiring the constant service of persons on any part of the cars except the rear platform, to provide each car with an inclosure, constructed of wood, iron and glass, or similar suitable material, sufficient to protect such employes from exposure to the inclemency of the weather, but not so as to obstruct the vision of the person operating the car, at all times between November 1st and April 1st in each year. Trailers are excluded from this requirement, so that it applies only to cars on which the motive power is operated or controlled.

HON. GEORGE B. SHAW.

This act was assailed as unconstitutional on five grounds: That it was not an exercise of the police power of the state; it was class legislation; it impaired the obligation of a contract; it interfered with the liberty of contract between street railway companies and their employes; it imposed an excessive fine. The Supreme Court of the state took up these contentions in the case of State v. Hoskins, 59 Northwestern Reporter, 545, and decided the law to be constitutional. Any one, it says, acquainted with the extreme cold of much of the weather in this climate between the 1st of November and the 1st of April, and who knows, as everybody does, that the motorman on an electric car is obliged to stand in one place, always on the alert, his whole attention given to the means of controlling the motive power and the brake, and to looking out ahead, and unable, with due regard to his duties, to give attention to protecting himself from the cold, must appreciate that, when going at the rate of eight or nine miles an hour, perhaps against a head wind, and with the mercury below zero, the position of the motorman is one not merely of discomfort, but of actual danger to health, and sometimes to life, and the tendency of which is to disable him to some extent to perform his duties in the way that care to the safety of his passengers and of travelers on the streets requires. It has never been questioned that the police power of the state extends to regulating the use of dangerous machinery, with a view to protecting, not only others, but those who are employed to use it; and if it be conceded, as it must be, that the state may intervene by regulations in such a case, the court could not see why it may not in such a case as this. The act is within the police power. When a subject is within that power the extent to which it shall be exercised and the regulations to effect the desired ends are generally wholly in the discretion of the Legislature. The Legislature might have required the use of the prescribed inclosure only at such times when the cold reached a certain degree, or when storms prevailed, but it was thought fit to make sure of the result aimed at by covering the time of year when extreme cold and bitter storms may occur at any time; and that was within its exclusive province.

## Earnings of the Liverpool Overhead Railway.

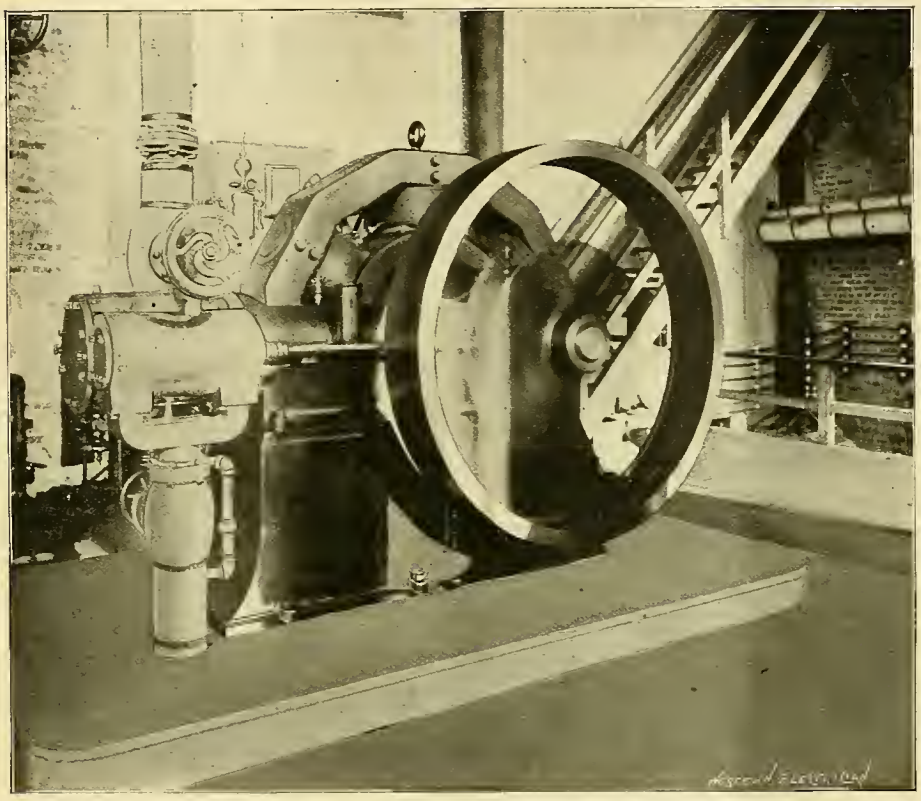
The *Railroad Gazette* publishes the directors' report for the first half of the present year of the earnings of the Liverpool overhead railway. The number of persons carried during the six months reached a total of 2,861,437—277,653 first class, 1,246,975 second class, and 1,336,809 workmen passengers at special rates. These figures, as compared with the two previous half years—that is, since the opening of the line—show a steady increase. Duringthe last half year 50,483 trains have been run, making a total mileage of 25,349, as compared with 243,539 in the previous period. Punctuality has been well maintained with the automatic electric signaling system, 96 per cent. of the trains being on time. Of the 7 miles 5 chains authorized, 6 miles 4 chains have been built and are operated; the rest is in process of construction. The gross receipts for the six months approximate $100,000, while the working expenses are $74,735, giving a proportion of about 74 per cent. This is the same as for the previous half, when the amounts were $91,710 and $63,660 respectively, so that no great saving of cost in working the line has been achieved. The proportion seems high even for a short line with many stations. Although a greater train mileage has been made, yet the total expenditure on locomotive power is nearly 25 per cent. less than previously when the line was worked under contract at a fixed sum per train mile. The cost of fuel works out to .81 of a penny per train mile, and the total running expenses—including wages connected with the generating plant and motors, fuel, oil, tallow and other stores—do not exceed 2.73 pence per train mile, or about 5½ cents. Renewals and repairs under this head come to about $785, making a total of $15,895.

By far the heaviest item in the total expenditure is put down to traffic expenses, which include all salaries and wages, station expenses, etc., and this amounts to nearly one-half of the gross expenditure. The sum named—$31,380—covers salaries and wages, fuel, lighting, signaling, water and stores, clothing, printing and stationery (tickets, etc.), and is 20 per cent. heavier than for the preceding half. The net revenue—after paying interest on mortgage debentures and calls paid in advance—is sufficient with the balance brought from last half year to pay the full dividend of 5 per cent. upon the preference shares and a dividend of 1 per cent. upon the ordinary shares, with a balance of $5,000 carried forward. The Liverpool overhead line has thus taken a much shorter time to reach a dividend-paying stage than the less fortunate City & South London underground, although for the last half year the latter has done so much better that its directors have also voted a dividend.

## Electricity in a Brewery.

If one were to speak of electricity in a distillery it might be assumed that a sly allusion was intended to that high potential product frequently spoken of in the East as Jersey lightning. In a brewery, however, this confusion is not apt to exist, and hence the title of this brief description should convey at once the idea of a working installation of commercial electricity adapted to further the ends of those manufacturing operations which may be looked for in all well-regulated breweries, rather than any reference to the strange distillation (as it is shudderingly designated in the East) which masquerades under the name of the grandest electrical manifestation in nature. The products of distillers and brewers are so closely associated in the public mind—or, should it be said, in the public stomach?—that these prefatory words of explanation may be pardoned, although, to those expert in such matters, the distinction is doubtless clear enough. The electricians of the West are not versed in technicalities of this description, and are entitled to every possible assistance in endeavoring to comprehend the distinguishing qualities of alcoholic beverages. In the East greater attention is paid by electrical men to this field of knowledge, and less assistance would be needed.

The brewery in question is that of the Gottfried Brewing



ELECTRICITY IN A BREWERY.

company on Alexander street, Chicago, and for the benefit of those interested in the line of investigation outlined in the preceding paragraph it may be stated that its capacity is 200,000 barrels annually. This, however, is of little consequence to the readers of the WESTERN ELECTRICIAN, who will be only interested in the electric lighting plant, which is represented by the illustration given herewith. The engine and dynamo are directly coupled—the former of the Ideal type, with cylinder dimensions of 12 by 13 inches, and rated at 80 horse power, and the latter a six-pole 50 kilowattt machine made by the General Electric company and wound for 150 volts. The generator is of the smooth-body type, and the combination is run at the rate of 240 revolutions per minute. It can carry 800 lights, but only 450 incandescent and 18 arc lamps are connected. There are also a few fan motors in the office. Light is furnished in all the departments of the brewery—grain elevator, malt house, brew houses, wash house, stock house, barns and the like—and as the establishment extends on both sides of the street the conducting mains are led from the engine room to the opposite buildings in an underground tunnel. Steam is furnished for the engine-dynamo, house engines and mammoth ice machines by several tubular boilers, having an aggregate capacity of 450 horse power. The tiny switchboard, shown over the top of the dynamo in the illustration, is of marble and supplied with Weston instruments. The plant was installed by the Chicago Edison company and gives much satisfaction.

## Discussing Lightning Rods.

According to the New York *Sun's* report of the meeting of the American Association for the Advancement of Science at Brooklyn, August 21st, "Lightning-man N. D. C. Hodges, whose lecture on 'Lightning as a Case of Dissipation' followed a visit to Newark, has stirred up a row among his fellows. He has," says our contemporary, "on exhibition a lightning rod which, he says, will attract all the electricity lying around loose in the circumambient atmosphere and decompose it.

"His idea, which has a metallic ring in its rattle, is to run thin copper ribbons from the highest point of a building to the ground at intervals of forty feet. When the lightning strikes the rod it will be so busy consuming the copper wire that it will forget the building, which will escape unharmed. Seventy-five feet of the ribbon weighs a pound. The ribbon which is thus destroyed every time the building is struck can be replaced at a very small cost.

"The scientific persons in attendance listened politely to Mr. Hodges' remarks, and then impolitely figured the theory into such a condition that it had the appearance of being struck by the lightning he had sought to dissipate. Prof. McFarlane began to figure up in the right-hand corner of the blackboard. The unknown quantity was X. He proved that a mild stroke of lightning would destroy two or three million pounds of wire such as Prof. Hodges described. At the lower left hand corner of the blackboard Prof. McFarlane proved Mr. Hodges was equal to X. Not content with this, Prof. McAdie arose and punched two or three more holes into the theory. When put back into the niche where Prof. Hodges keeps his theory it had a very disreputable appearance."

## A Drastic Ordinance.

The aldermen of Austin, Texas, have adopted an ordinance regulating electric wiring in that city, so worded as to confer great and unusual power on the supervising officer, who is, in this case, the electrical engineer of the board of public works. Two sections will serve to give an idea of the whole:

Sec. 2. No material shall hereafter be used in the construction of electric wiring within the city of Austin, unless the same shall have been previously approved by the electrical engineer in accordance with the regulations governing wiring.

Sec. 3. The electrical engineer employed by the board of public works shall have general supervision of the electric light and power plant, and no connection shall be made thereto, excepts as he directs and in accordance with the regulations governing wiring, and after written application has been regularly made and written permit granted, and he shall keep a record of all permits issued, which shall be regularly numbered in order of their issue. He shall, in being served with a notice requiring him to visit and inspect any building upon or in which work is being done under any of the provisions or this ordinance, do so forthwith.

The Pennsylvania Traction company of Scranton, Pa., has let contracts for building 43 miles of electric railroads to connect with a number of towns around that place.

## The Electrical Purification of Water.[1]

By THOMAS M. DROWN, M. D.

In this electrical age, when a new application of electricity to every-day needs is a matter of daily experience, it does not surprise any one to hear of the practical use of electricity as a purifying and disinfecting agent, particularly as we are accustomed to think of it as a force which purifies as well as destroys. The electrical purification of water and sewage appeals to most persons, therefore, as a process likely to be both potent and effective. There is, moreover, to some minds a peculiar satisfaction in the contemplation of a subtle force which acts in a mysterious way, and to such minds an explanation is often an unwelcome disillusion. Inasmuch as considerable prominence has been given in the last decade to methods of electrical purification of water and sewage, it may not be uninteresting to state briefly just how this purification is effected and the principles on which it rests.

We may distinguish two classes of so-called electrical purification: (1) Those which electrolyze water, liberating oxygen at the positive pole; and (2) those which electrolyze a solution of common salt and liberate chlorine in the same way.

The Webster process for the purification of sewage, of which a good deal was once heard, belonged mainly to the first class, although, by reason of the chlorides contained in the sewage, it fell also, in part, into the second class. The oxygen liberated at the positive pole, while in the nascent state, was supposed to oxidize some organic matter; but as this pole was composed of iron plates the oxygen was mainly consumed in oxidizing this iron, and the oxide of iron thus formed acted as a precipitating agent on the sludge in the sewage. The process was thus mainly one of chemical precipitation of sewage by means of oxide of iron, which was formed by a current of electricity passing through the sewage. Much was hoped from this process, but it never passed, as far as I am aware, beyond the experimental stage.

The possibility of oxidizing organic matter on a large scale by means of nascent oxygen liberated from water by the electric current will probably never be more than a dream. Attractive as the process seems, the necessary conditions for accomplishing it could probably never be realized on a city's water supply or on its sewage. One word in this connection about the nascent state of an element, of which we hear so much nowadays. It is a well-known chemical fact that elements just liberated from combinations are much more active than in their ordinary condition. Nascent hydrogen, for instance, is a powerful reducing agent; nascent oxygen a powerful oxidizing agent—properties which are lost when these elements have assumed their molecular condition.

In some of the recent literature which I have read on the electrical purification of water I have come across the idea that a nascent substance is one that is fresh in contradistinction to one that is stale; as if, for instance, oxygen liberated from water a minute ago would be more active than if it had been formed one hour. This is very wide of the mark; it is only at the very instant of formation that an element has enhanced powers due to its nascent or new-born condition.

The more recent systems of purification of water and sewage by electricity belong in the second class, that is, the decomposition, by electrolysis, of a solution of common salt. When a solution of salt (chloride of sodium) is decomposed by electricity, we have sodium liberated at one pole and chlorine at the other. The sodium is immediately oxidized and combines with the water present, and a solution of caustic soda results. By suitable mechanical contrivances the chlorine gas may be conducted away from the other pole as fast as liberated and collected as such. This method of making caustic soda, it may be said incidentally, is yet more or less in its experimental stage; but it seems not unlikely that the electrolytic production of caustic soda from common salt may become one of the world's great industries.

But if instead of separating the caustic soda and chlorine from each other in this process they are allowed to recombine, we have a complicated series of reactions, resulting in the formation of various products dependent on the concentration of the liquid and its temperature. The principal product under ordinary conditions is sodium hypochlorite, variously named chlorinated soda, chloride of soda, and, in pharmacy, Labarraque's solution. A corresponding and entirely analogous compound is the so-called chloride of lime or bleaching powder, in which lime takes the place of soda.

This, then, is the substance, sodium hypochlorite, with which we have to deal in the method of electrical purification which depends on the electrolysis of a solution of salt or sea water. When the current of electricity has, in the manner above described, formed a sufficiently concentrated solution of sodium hypochlorite, this solution is mixed with the sewage or water to be purified.

I would remark, first, that there is nothing new in the application of electricity to produce the hypochlorites, except so far as the introduction of the modern dynamo enables us to generate electricity at a much less cost than formerly, and consequently to use it economically in industrial chemical operations. Second, there is nothing new in the use of sodium hypochlorite as a disinfectant, deodorizer and germicide. In the very valuable report on disinfectants published by the American Public Health association in 1888 the hypochlorites were shown, experimentally, to be among the most effective of all disinfectants in their action; 1 per cent. of a solution of sodium hypochlorite containing 6 per cent. of available chlorine, destroyed the "bacillus anthracis" in two hours; 2 per cent. of this solution was effective in thirty minutes.

Of the corresponding lime salt, or bleaching powder, the committee reported that a solution of this substance containing 25 per cent. of available chlorine was effective in a 1 per cent. solution in one or two minutes, and that a solution of one-fourth of this strength would kill "bacillus anthracis" and "bacillus subtilis" in two hours. The two hypochlorites of sodium and calcium were thus shown to be

1. From the *Technology Quart rly and Proceedings of the Society of Arts*, Boston.

equally efficacious, the activity depending on the amount of hypochlorous acid present, or, in other words, of available chlorine.

The so-called electrical purification of water by treating it with an electrolyzed solution of salt is thus seen to be simply a process of disinfection by sodium hypochlorite; electricity, as such, has nothing to do with it. There is nothing peculiar in the sodium hypochlorite produced by electrolysis; it has no different properties from that made by the ordinary process of passing chlorine into a solution of caustic soda. That other compounds are formed in small amounts by the action of chlorine on caustic soda is true, but it has not been shown, nor is it probable, that any one of them has as potent germicidal and oxidizing power as the hypochlorite.

Ozone is generally supposed to cover a multitude of sins of pollution and quietly to destroy them; but we do not know much, if anything, about its germicidal power, and there is certainly no good reason for attributing any of the disinfecting action of an electrolyzed salt solution to ozone, even did we certainly know it to be present.

It is unfortunate, I think, that the advocates of this system of purification of water and sewage are not content to attribute the purifying action of the electrolyzed solution of salt solely to the hypochlorite formed. There is nothing gained scientifically by calling it "electrozone" or an "electro-saline solution," for there is nothing mysterious about its action, as these terms would lead one to suppose. Nor is it proper to speak of this system of purification in any sense as an electrical one. If one were to purchase two bottles of sodium hypochlorite of identically the same composition, one prepared by a chemical process and the other by the electrolysis of a salt solution, he would not expect to find them called by different names. To call the latter an "electrical disfectant" would be simply fantastic.

Finally, is it desirable in any case to treat a city's water supply with a powerful disinfectant like the hypochlorites?

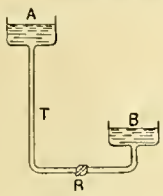



FIG. 1. CONTINUOUS CURRENT. RESISTANCE.

When the question is put in this bald form I cannot think it will receive the approval of engineers and sanitarians. Leaving out of consideration the difficulties and cost of disinfecting effectively and uniformly the water supply of a large city, the idea itself of chemical disinfection is repellent. Every city should jealously guard its water supply. It is a sin against decency and good morals to permit the pollution of drinking water by sewage and house drainage. It is a still greater wrong, not to say a foolish blunder, to permit the open pollution of its drinking water streams and then systematically to disinfect them.

In cases where a water supply has got into such a hopelessly bad condition that nothing will render it safe but disinfection by chloride of soda or chloride of lime, it is high time, I think, to abandon the supply, and in this opinion I feel sure most waterworks engineers will coincide.

## Electrical Phenomena Illustrated by Applied Hydraulics.

The teacher is often put to his wits' ends for comparisons with which to illustrate to the student some complicated or strange phenomenon. The movements of water are often used to illustrate some few of the first principles of electrical conditions, but the following, which is the work of G. Claude, is far more thorough and complete in this direction than anything preceding it, and will certainly enable the student to better understand and the tutor to explain many electrical phenomena.

For instance, nothing is more readily seen than that a current of water, other things being equal, will flow more rapidly

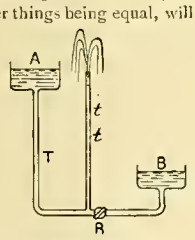



FIG. 2. SELF INDUCTION. EXTRA CURRENT.

with an increase of head, but with a current of electricity we see nothing, except the effects produced, as in the increase of illumination in an incandescent filament with an increase of potential, and the mind is not always satisfied with mere results. Our philosophical natures demand something more.

But if we remember that this incandescence corresponds to the disengagement of heat occasioned by the friction of a liquid in a tube; that this increase of incandescence may be compared to the increased friction due to a more rapid movement of the flowing mass (the equivalent of an increased head), and if we do a little reasoning on causes and effects in the case, we will assist the electric current to materialize before our mental vision, and the comprehension of its divers properties will become more clear to us. The expression "current," as applied to electricity is a wonderful aid in illustrating and comprehending the phenomena.

Now, while it is not possible that perfect analogies exist between hydraulic and electrical action, there is still enough similarity to render the study not only interesting but instructive.

### I.—CONTINUOUS CURRENT.

A vase *A*, Fig. 1, is placed at a certain height *h*, above another, *B*, with which it is connected by a tube. *B* is assumed to have a surface sufficiently large to contain the flow through *T* without sensibly increasing its level, while *A* is furnished with a supply which maintains its level despite its losses by escape through *T*, and we have the analogy of battery or other source of electromotive force.

For a given length and cross-section of tube the flow of

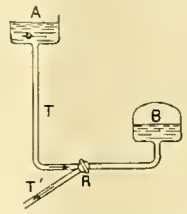



FIG. 3. CAPACITY. FIRST CONDITION.

liquid will be dependent on the friction, that is, on the polish of the interior of the conductor; the nature of the interior, then, to an extent is comparable to the nature of an electrical conductor. It is evident also that this resistance opposed to the flow of the liquid will be increased with a lessening of the cross-section, and with added length. The similarity to electrical resistance is quite perfect. The difference of height corresponds to difference in potential, and the analogue of intensity will be the weight of the liquid flow into the time consumed.

*Self-induction.*—Suppose now we suddenly open the cock *R*, permitting the liquid a free path between *A* and *B*. The liquid will not move instantaneously, because of its inertia, which must be gradually overcome, as if there were an augmentation of the resistance in the tube; and reciprocally, when the liquid has assumed its movement, we cannot instantaneously stop the flow because of a certain reaction which is simply the restitution of the energy absorbed while putting it in motion. We see here the influence of inertia in the liquid opposing its movement in the first instance and opposing the cessation of motion in the second—analogies of the action of the self-induced currents in their opposition to the direct current flow.

A second illustration of this action is found in the succeed-

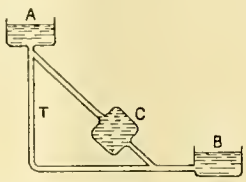



FIG. 4. CONDENSER IN DERIVATION. FIRST CONDITION.

ing experiment. In this the element of friction is left entirely out of the question. From this we can draw some interesting conclusions; once the fluid is set in motion the flow is established and the movement is uniform and constant in both rate and quantity, exactly as if there were no inertia. The interference of this disturber is limited to the moments of the establishment and the cessation of the flow. By analogy we see that in an electric circuit in effect the same phenomena is present—during the flow of current self-induction is not apparent through its retarding quality.

We will place before the stopcock *R* a tube *t* open at the upper extremity, Fig. 2. Now suddenly close *R*. All the energy stored up during the putting in motion of the liquid in *T* being forced to expend itself at a single effort, but not being constrained to expend its energy in the form of reaction against the walls of the tube *T*, because there is another road of an easier character, an overflow occurs through *t* which rises to a greater height than the source *A*, and the more suddenly the cock *R* is closed the more violent will be this fountain action. In the same manner, and for the same reason, the extra current spark rises to a potential higher than the source which gives it birth.

Finally, no matter how thin or how long a conducting tube may be, a certain retardation is ever present, and the same is true of a wire or other electrical conductor, even in rectilinear lines, with but few exceptions.

*Capacity.*—We will now consider this element. When we desire to represent capacity we compare it, sometimes to a vase *B*, Fig. 3, partially filled with a gas of which the compression proportional to a difference of level of the lower receptacle—or perhaps better, the different levels *A* and *B*, will represent a counter electromotive force; or again, a vase *B*, in which there is a certain elasticity in the walls, the tension of these will then illustrate the force equally well as gaseous elasticity. We will adopt the first illustration, as in Fig. 3.

The difference in level will be shown by the compression of the gas in *B*, because of the initial pressure of the column *A T*, and the entrance of a portion of liquid forced against *B*. There is in *T* a charging current, which is gradually less until the two forces, the electromotive force and the counter electromotive force, balance, when the current becomes *nil*.

We also see that now the quantity of liquid flowed into *B* expends no power, but is pent up or stored until when the pressure or tension is removed, there will be a return movement of the liquid through the elasticity of the gas—a discharge current. This action is quite analagous to the action of a condenser put in action by a constant current: a charging current at first intense, but rapidly diminishing in pressure as the counter pressure increases, until an equilibrium is attained; and now, on removing the charging current, we may discharge the electrical magazine (the stored-up current), which has become an electromotive force direct instead of a counter electromotive force, either in the form of heat through a conductor of proper thickness or in the form of a spark.

But again, other circumstances are not fully in accord with ideas which are commonly advocated, and this illustration has been adopted to show the fallacy which is so commonly repeated as to the charge of a condenser and to which it corresponds precisely. Thus, if we admit this method of representing the idea of capacity we are forced to admit the

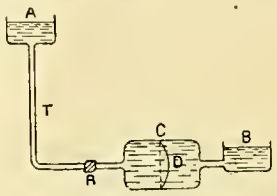



FIG. 5. CAPACITY. SECOND CONDITION.

oft committed error that the charge of the condenser is created by an afflux from the source of electricity to the condenser through an accumulation analagous to an accumulation of matter. In other words, if we wish to represent in this hypothesis the equivalent of several condensers in tension with a common difference of potential, or again, a condenser in derivation on a conductor, this representation would be impossible; in the latter case, for example, we will have a condition like that in Fig. 4; that is to say, that the difference of level, after having accomplished the expansion of *C*, continues to send by the same route a permanent flow of liquid, which evidently does not fit the conditions of the condenser.

For these reasons we are constrained to seek a primitive representation of capacity, a new representation which will be more perfectly in accord with the facts. A vase *C*, Fig. 5, open at its two extremities and perfectly full of liquid, shows at its center an elastic diaphragm *D*, which completely obstructs the flow. Now if we connect this system with a source *A*, higher than the vase *C*, the diaphragm will be forced out of the perpendicular, and the fluid will consequently rise in *B*. We see the charge is represented in this illustration by a current analogous to that which traverses an ordinary conductor, and which we do not now compare to an accumulation of matter, because the liquid in *B* remains the same in quantity before and after the charge, and has simply

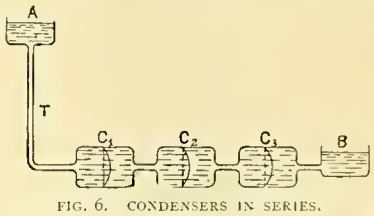



FIG. 6. CONDENSERS IN SERIES.

been displaced. What has varied during the charge is only the tension of the membrane. The energy developed has simply augmented the tension, and reciprocally during discharge it will be this membrane which, returning to its normal condition, returns the bound energy. It is the diaphragm, then, which in the charge plays the principal role. It should be the same in the condenser, if our comparison is exact, for the dielectric is the equivalent of the membrane. The experiments with Leyden jars having removable armatures show unequivocally that that the charge resides in the dielectric, and not in the electrode, and we know that as a sufficiently elevated source of supply of fluid will break down the elastic membrane *D*, so will a sufficiently high potential difference pierce the dielectric.

We may then conclude that the charge of the condenser

is rather an accumulation of energy than of quantity; that this accumulation is obtained by a modification of the molecular condition of the dielectric, produced by the passage of the charging current, which serves simply as a vehicle to the energy necessary to accomplish this modification. The law $W = \frac{1}{2} Q E$ will signify, then, that the pent up or bound energy in a condenser is equal to one-half the product of the electromotive force into the quantity which has been displaced, and not the quantity held by the condenser. Such is, simply stated, the material representation of Maxwell's ideas on this subject.

Nothing is easier now than to represent a battery of several condensers in tension or series, Fig. 6, where the same electromotive force charges all simultaneously, and of which

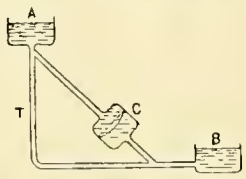



FIG. 7. CONDENSER IN DERIVATION.

their counter electromotive force is aggregated to equalize the direct current flow of a condenser in derivation on a conductor, Fig. 7.

*Accumulators.*—With some complications required by the necessities of the case, we may represent electrical accumulators in a manner identical with condensers, although they set up two different actions, like condensers of very large capacity. We are forced to the conclusion in this case that, like the condenser, the accumulator does not represent the storing up of a quantity of electricity, as is expressed when we say that the accumulator stores up so many ampere hours, but has stored up an amount of energy of which the charging current has simply been the vehicle.

Only in place of a molecular change in the dielectric of the condenser, it takes the form of dissociation of the chemical elements of the electrolyte which, after all, is again but a change of molecular condition.

## II.—VARIABLE CURRENT.

*Electrical Oscillations.*—Before leaving this branch of the subject let us attempt to represent by hydronamic analogy one of the most curious electrical phenomena, the oscillating discharges of condensers.

We have understood up to the present that in the charging of the receptacle in Fig. 5, under the pressure exercised by the superior level of $A$, the inertia of the liquid circulating through the tube $T$ was negligible, because of this being short and of small cross-section. Suppose now that we take a tube of greater cross-section, Fig. 8, and establish the communication between $A$ and $C$ by the aid of the stopcock $R$. The liquid will pass from $A$ to $C$, forcing the diaphragm toward $B$, increasing this strain until an equilibrium is formed between $A$ and $C$, but at this moment the liquid in the tube, having a high rate of speed from $A$ toward $C$, will not come to rest instantaneously. By virtue of its inertia and its acquired motion it continues to press upon the diaphragm, destroying the equilibrium. When this movement ceases to overbalance the tension of the opposing force (the elas-

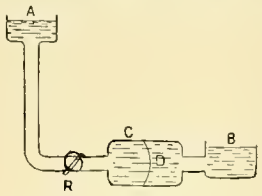



FIG. 8. OSCILLATIONS.

ticity of the membrane) a reaction takes place and the fluid is forced past the balancing point in the opposite direction, to be again surged against the diaphragm. These movements will gradually become weaker at each successive change of direction until quiet is restored.

It is proper to remark that in these oscillations there is always the same quantity of energy called into play, which prolongs the movement of liquid from $A$ to $C$ and the reverse. This quantity of energy is borrowed from the source under the form of quantity of movement; it is the quantity of movement which, when we open $R$, was bound in the liquid up to the instant when perfect equilibrium was accomplished.

Such is the explanation of the phenomena of oscillations which in electricity, by combining the effects of capacity and self-induction, produce such curious effects. The only difference between the two is in the rapidity of the oscillations—in the one case but few per second; in the other millions.

Special dispositions are necessary to realize the act corresponding to the opening of the cock $R$. If this is slowly opened we know that the oscillations will not be produced with the same perfection. In the same way in a circuit where the oscillations are extremely rapid these do not manifest themselves by the simple movement of a commutator, but to excite them we have recourse to the phenomenon of the disruptive spark, which is the equivalent of an instantaneous movement of the stopcock $R$.

The preceding example shows with what precision hydraulic analogy seizes the most complex phenomena. If, for example, the diaphragm is very large its counter pressure increases slowly and the oscillations are proportionably moderate, while presenting a greater amplitude. It is the same if the mass is considerable, for this mass moving in a given direction may stop quickly; on the contrary when the resistance is considerable it intervenes to dissipate the quantity of movement at the same time that the diaphragm absorbs it, resulting in diminishing the amplitude of the oscillations, rapidly deadening them, while increasing their rate of movement. All these results have their analogies in electric circuits.

## III.—ALTERNATE CURRENT.

In studying the alternate current, we must first represent an alternate electromotive force. To do this we are led to employ a vase $A$, Fig. 9, filled with liquid moving alternately up and down past the center horizontal $P$, which we will consider as the origin of the differences of head or level, and call positive the situation when $A$ is above, and negative when it is below the zero line. If we wish to show both difference of level and another characteristic of the current, we have only to suspend $A$ to a spring the length of which will be governed by the periodic time we desire to obtain.

*Alternate Electromotive Force Acting Against a Resistance Without Self-induction.*—Let us examine first a case where the vase $A$ is connected to another open vase $B$, Fig. 10, of

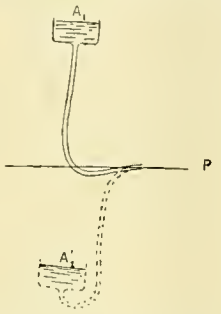



FIG. 9. ALTERNATE CURRENT.

which the level corresponds to the plane $P$, by a flexible tube of little length and small cross-section. This tube, according to the preceding considerations, corresponds to a conductor presenting great resistance and little self-induction, and we may, to simplify the conditions, entirely ignore the inertia.

Suppose that $A$ and $B$ being normally at rest have the same level, and we raise the vase $A$. The liquid is at once set in motion from $A$ toward $B$, its intensity increasing as the difference of level increases. Assuming that there is no inertia, the current has at each instant precisely the value it would have if the difference of head were to remain constant at that point. The maximum of intensity of current, then, will necessarily correspond to the point $A_1$, when the vase has reached its uppermost limit, and reciprocally the current will diminish with the reverse movement, until, passing the center or zero line $P$, it attains a negative maximum at $A_2$.

Now, neglecting inertia as a factor, we have the difference in level and that of intensity of the current sinchronous with the phase. Further, immediately we make a change of movement, the liquid at once conforms to the new order of movement.

The case corresponds to that of an alternate electromotive force acting upon a resistance without self-induction, and we may conclude that in this case the intensity of the current is in sympathy of phase with the electromotive force acting on a resistance without self-induction, and we are safe in assuming that the intensity of the current is in accrod of phase, with the electromotive force (having an instantaneous value $It$) equal to the instantaneous value of the electromotive force $Et$ into the ohmic $R$ of the circuit, and that finally, when we place this resistance against the electromotive force, the current immediately assumes its normal value without passing through a variable period to reach that condition.

*Electromotive Force Acting upon a Circuit Presenting Resistance and Self-induction.*—We will now introduce the inertia which we have not been able to eliminate except theoretically. Suppose we have the tube connecting $A$ and $B$ both large and long. Raise $A$, Fig. 11. By virtue of its inertia, the movement of the liquid does not precisely follow the ascensional movement of $A$; if we consider a position during the upward movement, say $A_2$, the liquid has not yet had time to acquire the speed which should correspond to this position were it stationary—that is, there is a retarding influence which will be greater in proportion to the rapidity of the upward movement.

The higher the point of comparison the more marked will the retardation appear, as at $A_3$, $A_4$, and $A_1$. A reversal of the movement now will show that while the head is being lowered down to a certain point, say $A_4$, there is no diminution in the flow of current, but below this

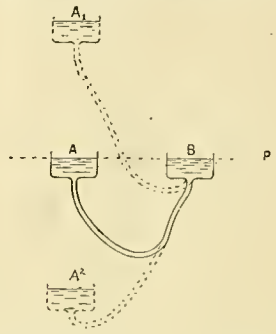



FIG. 10. RESISTANCE TO ALTERNATE CURRENT.

point the current will diminish, so that a point somewhere between $A_3$ and $A_1$, which we have assumed to be $A_4$, will correspond to a fixed maximum, which would produce the current at the moment. From this moment the current will no longer diminish, so that $A_4$ corresponds to the maximum of the current, and this maximum, in place of increasing with the difference of head, will decrease.

Now, the vase continuing to descend arrives at $A$. At this moment the liquid is again rapidly moved from $A$ toward $B$, because up to this point there was a positive difference of level. By virtue of its inertia it still flows from $A$ to $B$, and the movement is not checked until after the level $B$ is passed.

In the second part of the cycle matters do not pass exactly in the same manner as in the first half, because the current in place of being nil at $A$, as in the first instance, is not quieted until after the movement below the level is commenced. We can see that through this retardation at the point $A_2$, for instance, there is an intensity more feeble in absolute value than at the corresponding distance above the line at $A_2$ in the ascending movement; in other words, the retavd movement of the current is increased. This increased retardation will continue during several oscillations until uniform and perfect periods are accomplished.

We may then conclude from the foregoing that when inertia intervenes: First, intensity, instead of having at any time a value determined by such a change of level, really has a very small value. Inertia seems then to augment the resistance opposed to the passage of the liquid, increasing this with an increase of mass, and this not only during the short period of establishing the flow, but, as we have seen,

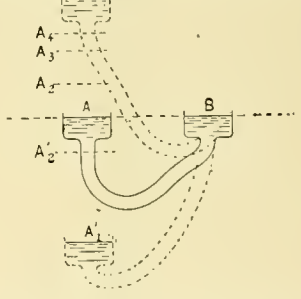



FIG. 11. SELF-INDUCTION IN ALTERNATE CURRENT.

when it is put in action by a constant difference of level permanently. It should be remarked, however, that this is only an apparent augmentation of the resistance. Second, the current is always retarded by a difference of level. There is between these a certain difference of phase. Third, the establishment of the normal condition is not instantaneous. It is preceded by a variable period of an oscillating character.

*Alternate Electromotive Force in a Circuit Having Both Resistance and Capacity.*—Remembering the representation of the condenser in a former instance, we will assume that $C$, Fig. 12, is connected to $A$ by a tube quite short, large and flexible, in which we will assume for the present there is no resistance to the passage of the liquid and no inertia. The two vases being at repose we raise $A$. A current from $A$ toward $C$ is set up and there is a progressive tension on the membrane, which is al-

most precisely proportioned to the difference of level, and the excess of pressure of $A$ over the counter force of $C$ is always quite feeble, and as it is this excess which determines the current this latter cannot at any time acquire a very considerable value. When $A$ has arrived nearly at the upper position of its route its movements are slower, as is also the current in $T$, and at the summit $A_1$, where the speed becomes nil, equilibrium is established between the tension and the difference of level and the flow cases. In this case, which is only theoretical, the current is annulled at the instant when the difference of level is a maximum.

Now, lowering the vase, the counter pressure due to the tension of the membrane tends to counteract the direct pressure, and when very near its level the current changes sign and flows from $C$ toward $A$. This flow continues, rapidly increasing, until by the time the membrane has assumed its normal position the vase has passed the center, and the current has gained an advance of the electromotive force a quarter of a period, which, we shall find by following the movements of the vase $A$, will persist indefinitely.

Theoretically this is correct, and it is in this sense more easy of comprehension. If, however, instead of a very large tube we substitute a very fine one, the movements of the diaphragm will be, of course, much more sluggish, both on the rise and fall of the vase $A$.

From the foregoing we see that:

First—When a condenser is placed in series with a resistance against an alternate electromotive force the circuit is the seat of alternate current; the condenser, in place of presenting an infinite resistance, as with a direct electromotive force, presents continuously a relatively feeble resistance, which diminishes as the capacity and frequency are increased.

Second—The simultaneousness between the maxima and extinction of the electromotive force and the intensity which exists with a perfect resistance in circuit does not exist when a condenser is placed in series with the resistance. The intensity is then in advance of the electromotive force, and this lead or advance being greater in proportion to the frequency, the resistance and the capacity are correspondingly less, within a limit of one-quarter of a period.

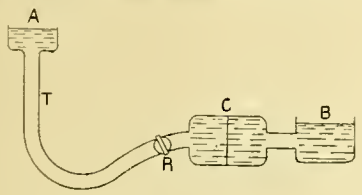



FIG. 13. SELF-INDUCTION AND CAPACITY IN SERIES, RESONANCE.

Third—When we place a condenser and a resistance in series with an alternate electromotive force, the current does not immediately take up its normal movement, but requires time to establish itself.

*Alternate Electromotive Force in a Circuit Comprising Resistance, Self-induction and Capacity in Series.—Resonance.*—Connect $A$ by a long tube of large section to the diaphragmed vase $C$, Fig. 13, thus rendering the inertia considerable and the friction comparatively negligible. If we suppose for an instant that $A$ is placed in a permanent position, and if we suddenly open the communication at the cock $R$, we know that this will establish an oscillatory movement of current in the tube $T$; that the periodic time of these oscillations is determined by the fundamental vibratory rate of the system (capacity of $C$, mass of liquid, amount of friction, etc.) but is independent of the difference of level, just as the longer and shorter oscillations of a pendulum are isochronous. In other words, the period of oscillation is, in a manner, a characteristic of the system $ATC$.

Now substituting a variable position for $A$ with a uniform period for its excursions, those oscillations which are proper to the system will tend constantly to superpose themselves on the resulting movement of the liquid.

If the movement of $A$ is uniform in its beats, and if its period is something near the oscillations spoken of above, the vibrations of the liquid will gradually fall into concord with the system; just as a person in a swing will gradually by alternately changing his center of gravity arrive at a point when the opposing forces will just balance the effort and the vibration will remain constant. But suppose these opposing forces are nil; that is to say, that the resistance opposing the flow in $T$ is nil, and the elasticity of the diaphragm is perfect. The oscillations will then increase in amplitude up to the highest limit, just as the swinger after reaching a certain amplitude must cease effort or incur a threatening danger.

*Alternate Electromotive Force Acting in a Circuit Having Self-induction and Capacity in Derivation.*—The hydrodynamic representation of this case, Fig. 14, assumes that the inertia of the branch $C$ is negligible. We endeavor to seek the value of the current below the junction $M$.

This case is more simple than the preceding, for each branch may be considered singly, and it then remains to determine the result of the two movements.

According to a former hypothesis, when, after a certain number of oscillations of $A$ tending to establish a uniform rate of vibration, the vase $A$ is at the upper limit of its movement, the current in $T$ is nil, and the current in $C$ also, but the compression of the diaphragm is at its maximum, the current of liquid below $M$ is also equally motionless. Now $A$ commences to descend, the liquid in $T$ is put in motion from $A$ toward $B$. But now the elasticity of the diaphragm $C$ produces an upward current which opposes the movement in $T$. The current then below the junction will be the difference between these two. If $T$ is greater the current will flow toward $B$ and will be positive, but if $C$ preponderates, then the resulting current will be negative. Finally there will come

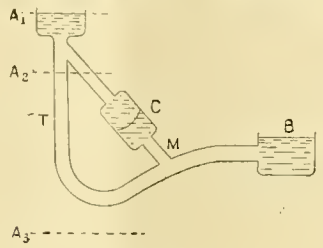



FIG. 14. SELF-INDUCTION AND CAPACITY IN DERIVATION.

a point at which the two will be equal. Now all the liquid which flows through $T$ toward $B$ will be drawn up by $C$, and the resulting current will be nil, and if this relation between the conditions at $C$ and $T$ be represented by a position ($A_2$) of the vase, we can conceive that there will be a similar point $A_3$ where the same condition reversed will obtain.

Again, with a change of the level the resistance will be evidently annulled by the movement assumed to be without resistance, and the intensity will be infinite. The neutralization of the inertia by the capacity will determine only oscillations of a uniform period. If these oscillations are too slow the current in $T$ will preponderate, and if too rapid $C$ will have the advantage.

There are other cases which are equally capable of demonstration by this method, but enough has been given to illustrate some of the more important conditions of electricity in motion. The illustrations are reproduced from *La Lumiere Electrique.*

## Municipal Lighting Plants in Kansas.

A recent Kansas law confers on the council of a city of the second class the right to provide for and regulate the lighting of the streets, and under this act the Supreme Court of the state holds (State v. City of Hiawatha, 36 Pacific Reporter, 1,119) that the mayor and council have the power to purchase an electric plant for lighting the streets. That clause in the act which authorizes them to make contracts with any person, company or association for such purpose, the court holds, does not restrict them to supplying light by such a contract, but they may in their discretion provide lights for the streets and public places, in such manner as they deem best, provided they do not exceed their powers in incurring obligations or levying taxes.

## Trolley Parties Popular in Philadelphia.

The popularity of trolley parties in Philadelphia is on the increase, and large crowds of young people are enjoying

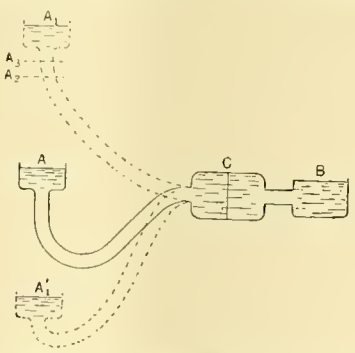


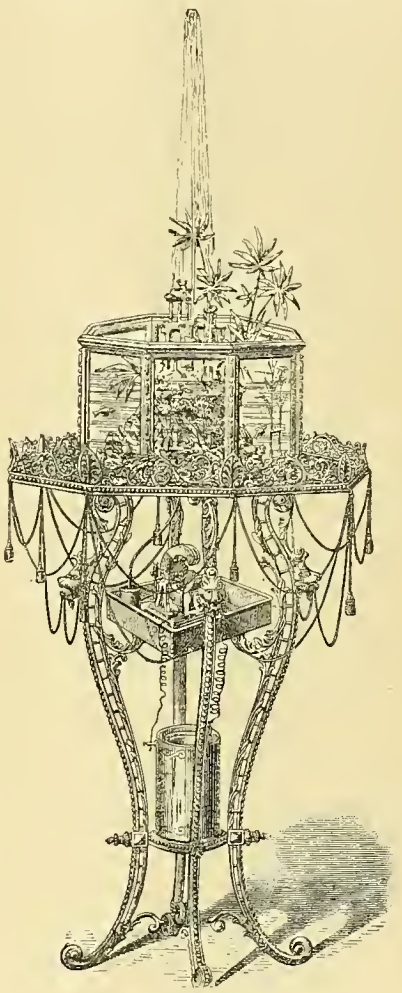

FIG. 12. CAPACITY OF ALTERNATE CURRENT.

pleasant evening rides through the city and into the suburbs on board the summer cars, according to the *Ledger.* Up to six o'clock Wednesday evening nine cars had been engaged of the People's company for rides over the Fourth and Eighth streets route and out Germantown avenue to the terminus beyond Germantown. Monday evening 17 cars carried different trolley parties over the same route, and one party of 40 went to the depot at Eighth and Dauphin streets, only to find that a spare car could not be secured. Six parties were carried over the Tenth and Eleventh streets line of the Electric Traction company on Monday evening, and last evening there were three. Most of the parties engage a car in good season, but sometimes a jolly crowd is made up on the spur of the moment and a car secured at the depot.

## Electric House Fountain.

An electrically operated fountain, designed as an ornament to a drawing room, and brought out by Louis Heinrici of Zwickau in Saxony, Germany, is illustrated by the accompanying cut. The idea is something of a novelty in the United States, but the combination is a perfectly practical one, and, being self-contained, can be readily removed from place to place, adding distinction to various parts of the house, if desired.

This ornament consists of a tastefully decorated flower stand, with a small aquarium and a spouting jet of water. Under the level of the plants and flowers is a square zinc tray, containing an electric motor attached to a small pressure pump. The zinc tray also acts as a reservoir for water, and the pump, operated by the motor, keeps a constant circulation through the aquarium and fountain above. Current for the motor is obtained from a powerful battery cell placed on a separate shelf beneath the zinc tray. In the cut all the actuating apparatus is shown, but of course the battery, motor and pump could be readily enclosed, if desired, to enhance the ornamental character of the fountain.



ELECTRIC HOUSE FOUNTAIN.

The battery used is new, and its construction is not without interest. It consists of a brass cylinder, taking the place of the ordinary battery jar, and an inside brass cylinder, the latter being perforated, to promote the action of the battery fluid. A porous cup with a zinc pole is placed within the inside cylinder. The space between the two brass cylinders is filled with bluestone (sulphate of copper) and the space between the inner cylinder and the porous cup is filled with a concentrated solution of sulphate of copper. Inside the porous cup, surrounding the zinc, is a strong solution of rock salt. This battery is said to be very effective, but when not in use the porous cup must be removed. The cut is from the *Elektrotechnische Anzeiger.*

Judge Swan, of the United States Circuit Court at Detroit, in a decision rendered August 21st, denies the motion for a rehearing in the Cody patent case, thereby affirming a previous decision of the same court in favor of the Consolidated Car Heating company of Albany, N. Y.

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IT is about time that reputable newspapers should discourage the reprehensible practice of attributing fires to electric wires without ascertaining the real cause. In many cases there is not the slightest reason or excuse for some of the statements made by the daily papers in this line. The *Chicago Evening News*, for instance, on August 17th, published what purported to be an account of a "fire at the Union League." Of course the account closes with the statement that "the cause was two electric wires which crossed." As a matter of fact there was not an electric wire near the fire, and no one who had any knowledge of the affair would for a moment attribute the fire to that cause.

AT a time when the financial skies are beginning to give evidence of a clearing-up it is cheering to note that, in the opinion of a leading investment journal, at least one branch of the electrical business has held its own. "Through all the time of depression and business uncertainty of the past year and more," this paper says, "there has been one large interest that has gone ahead with wonderful rapidity, seeming to possess the confidence of capital to such an extent that all its demands, no matter how heavy, were readily met. We refer to the electric railway interest. Its development has been wonderful, covering not only short lines within city limits but long ones tying together several outlying centers of population." Perhaps an electric railway man, remembering the price for which apparatus has been sold, would not take quite such a roseate view of the situation. Still it is encouraging to reflect that the activity in this line has been so marked as to attract the approving comment of those who are accustomed to judge commercial enterprises at their true value.

THE situation in Korea is not without its amusing features, and, strangely enough, if a writer in the London *Times* is to be believed, electricity plays a part in this curious feature of life in the far East. It seems that the only European not paid from the customs revenue who gets his pay regularly is the electrician at the palace. The king and all his court are so afraid of ghosts that they often sit up all night. There are sorcerers, it appears, and the electric light also, to keep off the ghosts. If the electrician's pay falls into arrear the light apparatus mysteriously breaks down, and cannot be repaired until he is paid up. The employment of electricity to ward off the ghosts that would otherwise affright the royal vision is certainly novel, but it is only another illustration of the cosmopolitan utility of the electric current.

IN discussing the recently raised question of the possibility of recurring to the double-trolley system for electric railways, to avoid the electrolytic danger of ground returns, the London *Electrician* suggests that electrical manufacturers may yet advertise their wires by the catch-line:

Double your trolleys and halve your troubles.

The trend of opinion is certainly more favorable to a consideration of the obvious advantages of the double-trolley than, say, a year ago, when the idea of introducing two conductors over electric railway tracks would have been scouted as utterly out of the question. As other proposed remedies have been considered, however, and found impracticable or nearly as expensive as the double-trolley, thoughtful men are more and more coming to ask themselves the question whether it would not be better to seize the bull by the horns and adopt the one method known to afford effectual relief.

ONE reason why life in Chicago is so interesting, not to say exciting, is the constant succession of unusual events that engages the attention of the public from day to day. Is it a religious or educational movement, a strike, the founding of a museum, an explosion, a political convention, a murder or what not, the item of interest that floods the newspapers of the country with dispatches dated Chicago is sure to be of great magnitude or possess some novel characteristic, giving the more subdued citizens of other communities an opportunity to exclaim: "Yes, to be sure; just what you might expect from Chicago!" Good or bad, Chicago deals in surprises and superlatives. This tendency doubtless explains the attempt made last week by Charles C. Hoffman to end his life by clutching an arc light conductor. Mr. Hoffman was not successful in his endeavor, but he at least demonstrated the sincerity of his purpose to present the world a novelty in the suicide line, with the brand of Chicago upon it. He was not an electrician, else he would have chosen a better "ground" than a pile of wooden boxes when he grasped the wire that was to furnish him the means of exit from a troubled world. The attempt was made at an arc lamp on the widely renowned Halsted street, and the only result was a shock that threw the innovator to the ground and a trip to the hospital. Mr. Hoffman did his best according to his lights. He failed, but he will be remembered as conceiving a new use for electricity and as adding a unique sensation to Chicago's list.

IN this issue is presented a paper by Dr. Drown on the "Electrical Purification of Water," which will doubtless attract considerable attention among those who have followed the recent experiments and publications on this interesting subject. The author evidently believes that "the electrical purification of water and sewage appeals to most persons as a process likely to be both potent and effective, especially as there is to some minds a peculiar satisfaction in the contemplation of a subtle force which acts in a mysterious way, and to such minds an explanation is often an unwelcome disillusion." The process of purification and the so-called electrical methods are briefly explained. It is contended that the so-called electrical purification of water by treating it with an electrolyzed solution of salt is thus seen to be simply a process of disinfection by sodium hypochlorite, and that electricity, as such, has nothing to do with it; that there is nothing peculiar in the sodium hypochlorite produced by electrolysis; that it has no different properties from that made by the ordinary process of passing chlorine into a solution of caustic soda. That other compounds are formed in small amounts by the action of chlorine on caustic soda is true, but it has not been shown, it is claimed, that any of them has as potent germicidal and oxidizing power as the hypochlorite. Dr. Drown very pertinently calls attention to the fact that there is nothing mysterious about its action and that there is nothing to be gained scientifically by calling it "electrozone" or an "electro-saline solution." On the contrary, he contends that it is misleading and improper to speak of this system of purification as an electrical one in any sense. Another point which the author raises, which has much force, is that a city should not take its water supply from polluted streams. Means should be provided for preserving the purity of the water, preventing contamination, and if this is found impossible it should be abandoned and some other source of water supply be obtained. This position will be generally commended.

CONSIDERABLE attention has been given the subject of improving the postal service in large cities by taking advantage of the trolley and cable street railway lines for transmitting mail matter between sub-stations in different parts of the city. Postmaster Hesing returned to Chicago last week much pleased with the results of a two weeks' visit to Brooklyn and Washington, having gone to the former city to inspect the postal car service recently put in operation between Brooklyn and Coney Island, and to Washington to urge its adoption in the Chicago postal service. According to Mr. Hesing the authorities at Washington are much pleased with the experiment in the East. "The Brooklyn postal car service," Mr. Hesing said, "is operated on the same principle as the service proposed for Chicago last June and is in every way a pronounced success. The service extends between Brooklyn and Coney Island, a distance of eight miles, and has eight stations where mail is received and distributed, one clerk doing the work. The cars are constructed on the combination plan, one end being for passengers and the other for mail, which necessiates the conductor and motorman being sworn in as government clerks. This latter feature of the plan would be obviated in Chicago because of the fact that larger facilities would be required for the mails, and a trailer could be attached to the regular cable and electric trains and devoted entirely to the government service. The government pays the street railway company on whose tracks the cars are run in the same way the railroads are now paid, each pound being settled for by the mile annually. The same would apply to Chicago." As has already been pointed out, the adoption of this plan would be considerable protection to the companies in times of labor difficulties. But there would be other advantages to the public, and there is no doubt the efficiency of the service would be greatly improved. Mr. Hesing said the department had authorized him to look over the field with the view to the adoption of the improved system, and had gone so far as to provide him with the necessary blanks on which propositions incident to the cost of construction of cars and other expenses likely to be incurred by the change, could be submitted for consideration at Washington.

MR. PREECE'S paper before the British association at Oxford on "Signalling through Space," contained some interesting accounts of recent experiments and discoveries in this line. In addition he said: "There is every reason to believe that we have detected distinct disturbances in our telegraphic circuits due to great electrical storms in the sun's photosphere, 92,000,000 miles away. The fact that these signals across space are effects of induction, transmitted through the air or the ether as the dielectric, is beyond the region of doubt, for they were produced between isolated and insulated coils, each forming a complete metallic circuit; but the part played by the earth at short distances when the earth was used to complete the circuit was not so clear." And again, Mr. Preece says: "A somewhat fascinating branch of this subject is the possibility of signalling across planetary space. Signalling between one planet and another is merely a question of degree. Magnetic storms and earth currents have some intimate connection with the sun, although Lord Kelvin has questioned the reality of the fact. The great storms and sun spots of March 30 and 31, 1894, were accompanied by very marked and peculiar sounds in telephones inserted in our long telegraph circuits. The storm of July 20th was not so distinguished. Strange, mysterious, weirdlike sounds are frequently heard on long lines of telegraph in the calm stillness of the night, but whether due to terrestrial or to cosmic causes, remains to be discovered. The sun's photosphere, when disturbed by spots, may be subject to violent electrical storms, and those vast clouds of incandeseent hydrogen that flame up with terrible velocity may excite electrical oscillations through etherial space of such frequency as to influence our terrestrial circuits. We may thus hear on earth the electric storms of the sun. But this is mere speculation, and the evidence before us at present is not sufficient to justify positive deduction. We shall continue to watch and record, and it is hoped that observers in other parts of the world will assist by making use of the telephones and telegraph lines at their disposal." This is indeed a most interesting branch of scientific research, opening, as it does, a fascinating field of speculation and examination to the student and observer.

## The Equipment for Electrical Engineering Laboratories.[1]

By D. C. Jackson.

When this subject was assigned to me by your secretary it was suggested that a discussion of the ideal equipment for the electrical engineering laboratories of engineering schools was not wanted. The discussion should be limited to the special electrical equipment that is necessary for use in engineering schools having a course in electrical engineering, in order that proper instruction may be given in their specialty to the undergraduate electrical engineering students. This seems to be a reasonable limitation, and in fact an essential one, if the discussion is to be of value. I doubt if any one is able, with our present knowledge of the requirements, to outline the true ideal equipment for electrical engineering laboratories. We can all tell what we now consider an ideal equipment, but in a few years it may be far from ideal. We are, however, faced by a positive condition which demands a first-class working equipment in the electrical engineering laboratories. How can the electrical laboratory equipment be made most effective, is a question for solution; how much and what equipment is required to fulfil the demand in the instruction, is another question which confronts us.

As we are dealing with electrical engineering laboratories, we will presume that they are attached to the engineering department over which a professor of electrical engineering presides. The electrical engineering department is therefore separated entirely from the physics department and is co-ordinate with the other departments of engineering. The practice at present common in many colleges, of placing the electrical engineering course with its class room and laboratory instruction under the direction of the professor of physics is just as absurd as it would be to devolve upon that professor the instruction in advanced thermodynamics and the design and construction of steam engines. It is equally absurd for the professor of electrical engineering to attempt to teach physics. Proper instruction in physics is essential to the student who is pursuing a course in electrical engineering, and the physics department must be well controlled and supplied with an excellent independent laboratory equipment. In addition to the ordinary general course in physics the electrical engineering student should gain, during his course in physics, a common-sense grasp of the elementary notions of electricity and magnetism, and of the "all pervading law of Ohm." The latter can be properly enforced in the laboratory by placing in the student's hands ordinary electrical instruments, such as galvanometers, bridges, voltmeters, amperemeters, etc. Before beginning his work in electrical engineering, the student's knowledge of Ohm's law and its common results should have become almost instinctive. The student should also become acquainted with the theory and practice of photometry. This should all be done in the physics department, and the equipment required for the instruction should be controlled by that department. Much of this equipment is quite different from that required by the electrical engineering department, but some of it is useful to both departments, and where students are not too numerous may be used to some degree in common.

With due regard for his preparation, it seems best to arrange the professional electrical studies for the average electrical engineering student in four divisions, in three of which laboratory work must be made an integral part of the instruction in a satisfactory course. The divisions are:

1st. Electromagnetism and its applications to special uses, with special reference to dynamos and motors.

2d. Electrochemistry (including primary and secondary batteries) and electrometallurgy.

3d. Alternating currents and alternating current machinery, including alternators, transformers, motors, condensers, etc.

4th. The special application of the preceding divisions in electric light, power, railway, mining, telegraph, telephone, and other types of plants. These divisions are of about equal real moment, but the last must be allotted more time in the lecture room than either of the others, but little or no laboratory time or equipment need be directly allotted to it. The laboratory equipment for the first three divisions only need therefore be discussed. The equipment that can be made useful in the fourth division is usually of an illustrative nature, and must be a matter of slow growth and collection as the electrical industries progress, rather than immediate selection.

While higher mathematics is a useful aid in each of the divisions, its limitations as an agent must be carefully shown in the class room and laboratory. For the purpose of educating the judgment of a student, and fully defining the limitations of theories and mathematical deductions, the laboratory is indispensable, and the equipment should be selected with this object in continual view. The equipment should be so selected and be of sufficient amount, that as much as one-half of the total time spent by the student under the direct instruction of the professors of electrical engineering, may be profitably devoted to the laboratory. The equipment, moreover, should be such that the work may as far as possible deal with fixed commercial instruments and machinery, and actually follow the methods of testing and research used in practice. The first three divisions should each be properly represented by a commercial laboratory equipment, in which every principle and operation is illustrated and made useful in every-day instruction under the direction of a man who has had experience in similar commercial work after having had a thorough theoretical training in preparation for his work. The laboratory work must always go hand in hand with the class-room work, illustrating and strengthening the latter. In this way the equipment may be made most effective in the work for which it is designed.

We will call the laboratory equipments for the three divisions, the dynamo equipment, the electrolysis equipment, the alternating current equipment, and consider the essential equipment of each separatly in the consecutive order given, since that is probably the best order for the student to take them up. It is well to remember at this point that engineering measurements are almost invariably quantitative and that the results from an engineering investigation which bear fruit are also nearly always quantitative. It is seldom that purely qualitative results may be accepted as satisfactory in engineering work. Therefore the laboratory equipment must be capable of doing quantitative work which is in general of satisfactory commercial accuracy and which may be made rigorously exact for purposes of exact investigation.

The first work that a student should take up upon entering the dynamo laboratory is a study of the methods of testing the magnetic qualities of iron. In this work testing by magnetometer, ballistic galvanometer and traction should be used. The apparatus for the magnetometric method is very simple and is generally at hand, as almost any reflecting galvanometer may be used for the magnetometer. For the ballistic method, a magnetizing yoke and proper test pieces should be supplied as well as a satisfactory galvanometer. Arrangements for determining the constant of the galvanometer and proper current measuring instruments must be supplied. For the latter, Weston amperemeters with proper scales and in good condition are entirely satisfactory. To determine the constant of the galvanometer several methods requiring their own special but simple apparatus should be used. The special apparatus for the traction method of testing iron consists simply of a magnetizing yoke with its test pieces. Here again an amperemeter is required. Indeed a good supply of first-class amperemeters and voltmeters is of the utmost importance in the electrical laboratory. These should be selected so that various types are represented, but for general use with continuous currents the Weston instruments are most satisfactory and should therefore be in a majority. Amperemeters with scales from 0 to 1, 0 to 5, 0 to 15 and 0 to 50; voltmeters with scales from 0 to 5, 0 to 60, 0 to 150, 0 to 600; and milliamperemeters and millivoltmeters are indispensable. The actual number of instruments required for use must depend of course upon the number of students who work in the laboratory.

In addition to the standard methods of testing iron which have been mentioned, there are several special devices constructed by different instrument makers, which are of some advantage in instruction, but which should not be purchased until all the essential equipment is supplied. Such are the iron tester using a bismuth spiral made by Hartmann & Braun, the Siemens & Halske device, and magnetic bridge arrangements.

It is not a bad plan to have various test pieces for use with the ballistic method made from cast and wrought iron and cast steel, of known chemical composition and degrees of annealing. These may be most conveniently in the form of bars to be used with the magnetizing yoke, or may be rings. By using various specimens for the class testing a very good idea of the differences to be found in different bars is given to the students. In this work the students should always be required to plot both the curve of magnetization and the permeability curve of his specimen, as well as to fully report his process.

After the testing for simple magnetic quality comes the measurement of the hysteresis loss and its companion, coercive force. For this purpose apparatus for the magnetometric method, with slowly varied continuous currents, should be provided. This may be similar to the apparatus for the magnetometric method of testing the magnetic quality of iron. If a sufficiently small number of students work in the laboratory, the same apparatus may be used. In addition to the magnetometric apparatus a couple of devices for testing hysteresis loss by alternating currents should be supplied. These methods are being improved so rapidly that it is almost impossible to say which are the best for fixed use in laboratory instruction, and much must be left to individual choice. Here again there are various excellent illustrative but unessential pieces of apparatus, such as the Ewing curve tracer, which should only be purchased after the essential apparatus is fully supplied, or which really belong in the field of the department of physics.

The writer makes all his laboratory work follow quite closely to his class room instruction, and therefore makes the work in the dynamo laboratory follow the plan of his text book on Electro-Magnetism and Continuous Current Dynamos. Consequently, after the students have completed their work in magnetic testing, they begin a study of the dynamo. The dynamo room must fulfill two objects: 1st. To furnish current for experimental work which cannot be conveniently furnished from the laboratory lighting circuits. 2d. To supply machines for laboratory testing. For the first purpose dynamos of various pressures driven by a steady power must be arranged so that they may be operated upon laboratory circuits as desired. This requires that a good automatic engine, which is used for no other purpose, be used to drive the dynamos, and that the machines be systematically wired to suitable distributing switchboards. A good storage battery of 60 or 70 cells is a most useful adjunct in this connection. For the second purpose it is desirable to have continuous current machines of comparatively small size—from 2 to 10 kilowatts capacity. Such machines are readily handled, are not readily injured, when injured are inexpensive to repair, and laboratory testing with the machines under load is always possible, while it would frequently not be so with larger machines. A dynamo laboratory in which a fair number of students work needs a number of such machines, which should be carefully chosen to represent the widest range of types and styles of construction. All these machines should be so arranged that they may be operated either as dynamos driven from a constant speed prime mover, or as electric motors.

Upon entering the dynamo room for work the student receives systematic instruction in handling the dynamos so that his work may proceed without danger to himself or to the machines. Determinations of the strength of the fields of dynamos when the armature windings are known are then made from measured speeds and pressures. This requires no instruments except voltmeters and ordinary speed counters. Following this comes the measurement of leakage by ballistic methods, and a comparison of the measured results with results calculated from the dimensions of the machines. This gives the student an idea of the large percentage of guess which must enter into such calculations. Tests of the magnetic circuits of dynamos, the regulation of dynamos and motors with different forms of field windings, effect of load on lead, characteristic curves, etc., all require the all-useful amperemeters, voltmeters and speed counters, which as already said must be on hand in sufficient number and with a sufficient variety of range.

Efficiency testing requires a more varied equipment, yet in this the amperemeter and voltmeter hold prominent places. In stray power tests and determinations of the losses by hysteresis and foucault currents in armature cores, amperemeters, voltmeters and speed counters supply all the information that is needed. Efficiency tests should always be made by stray power, live-load and dead-load methods. For the latter, convenient variable liquid, wire and lamp loads should be liberally supplied. One or more first-class bridges must be at hand for measuring resistances and standard instruments, such as Kelvin balances or Weston laboratory instruments, should be conveniently arranged for the calibration of the portable instruments. Stationary devices for the measurements of currents, such as a good calorimeter and a galvanometer arranged for use in the so-called Vienna method, should be properly mounted.

Recapitulating, the essential apparatus for the dynamo laboratory is:

Appliances for testing the magnetic and hysteretic qualities of irons, together with the necessary test pieces, galvanometers (plain and ballistic), standard solenoids, earth coil, condenser, etc.

Set of small continuous current dynamos and motors representing various types for laboratory testing.

Goodly supply of first-class amperemeters and voltmeters, of various types, with standards for use in calibration.

Instruments for measuring currents by different methods, bridges and special instruments for measuring resistances.

Various arrangements for loading dynamos and motors and testing their speed.

A number of portable storage cells to furnish steady currents which cannot be conveniently supplied from the lighting circuits and the dynamo room.

The electrolysis and alternating current equipments will not be taken up in so great detail. The former requires for the fundamental work a number of standard cells, silver and copper voltmeters, fine galvanometers, balances for weighing, accurate resistance boxes, devices for measuring the resistance and specific inductive capacity of electrolytes. For the advanced work is required a goodly supply of primary and secondary cells of various types which may be used in examination and testing, and a well equipped set of two or three good sized electrodeposition vats and arrangements for heating by the arc, with low pressure dynamos, and the amperemeters, voltmeters, and hydrometers which are necessary to carry out work on a considerable scale in electrodeposition and electrometallurgy. The electrolysis laboratory has received comparatively little attention in American engineering schools, but its importance makes it deserve an allotment of its full share of equipment and instructional force. There seems to be a time coming when the electrolysis equipment will be made equal in importance to the dynamo equipment in all first-class engineering schools.

The alternating current is receiving a preponderating amount of attention in many colleges, sometimes on account of the numerous striking and beautiful experiments which may be performed by the alternating current, and sometimes because of the attractive field of speculation which is opened by the use of polyphase currents in power transmission. It is not belittling the enormous power value of the alternating current to say that the equipment of each of the divisions should be given equal consideration, and no one should be given undue prominence to the injury of the others.

The effects of self-inductance, mutual-inductance, and capacity are at the root of a large proportion of alternating current phenomena, and the fundamental alternating current equipment should be arranged for the study and measurement of inductances. It would be a long step in advance if electrical engineering graduates were given as lively and practical a working conception of inductance and reactance as that usually given them of Ohm's law and its results. For studying inductances in the laboratory, various coreless solenoids are needed, which may be used for experimental and mathematical determinations of the coefficients. The methods of measuring the inductances of solenoids should include the direct measurement of self-inductances by amperemeter and voltmeter using an alternating current of known frequency, the comparison of self-inductances with each other and with mutual-inductances, the direct measurement of mutual-inductances by amperemeter and ballistic galvanometer, the comparison of self and mutual inductances with capacities, etc. After these measurements have been carried out by the student, using the simplest known methods, the measurements should be extended to include circuits with iron cores. These measurements require comparatively simple apparatus, but it should be on hand in sufficient amount. Carefully wound long and short solenoids of known constants, condensers of known capacity, bridges, alternating current amperemeters and voltmeters, a sensitive ballistic galvanometer, and a secohmmeter are essential for the work. A very convenient instrument for use in this branch of the work is a variable standard inductance, but its place may be filled by solenoids of known constants.

After inductances, the alternator and single-phase currents are in logical line. One or more small alternators are needed for this work, which may be carried out in much the same way as that relating to continuous current dynamos. The work, however, requires the introduction of two new instruments, the wattmeter and a device for taking alternating current curves. Wattmeters are difficult instruments to get in satisfactory form, but probably the Weston form is the best for general laboratory use, though a split dynamometer is a good instrument to have at hand. There is a considerable number of schemes for the tracing of alternating current and pressure curves, and more than one should be put into use. The relations of the current and pressure waves in circuits should be studied from the curves, as well as from measurements of the true and apparent energy in the

1 Read before the Society for the Promotion of Engineering Education, at Brooklyn, N. Y., August, 1894.

circuits. This study is finally applied to transformers, a number of which, representing various types of construction, should be in the equipment.

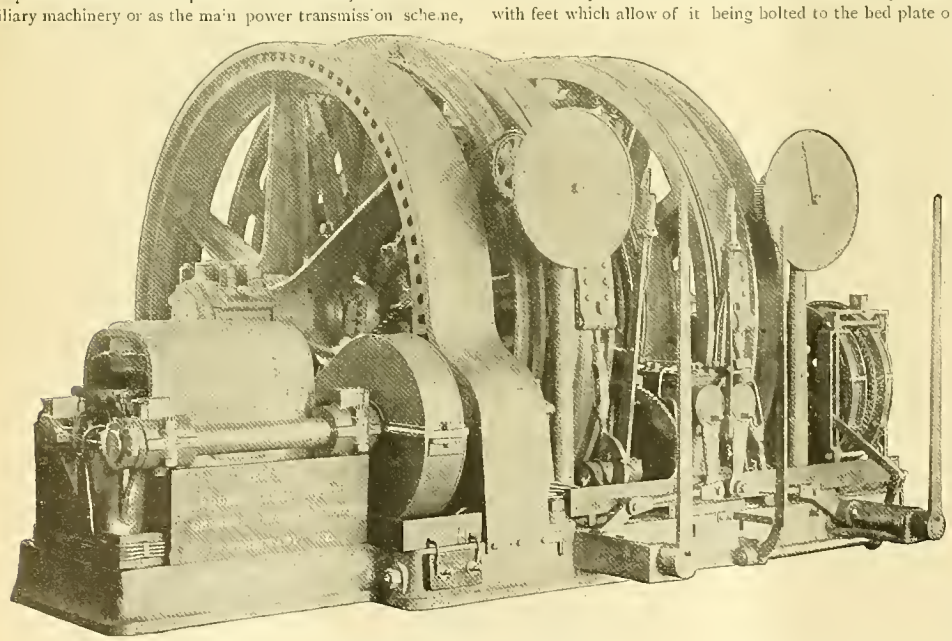
The laboratory equipment to be supplied for the study of polyphase current effects is as yet an open question. It seems desirable to have at hand polyphase currents of variable frequency and induction motors representing the different types of construction. The variable frequency polyphase currents may be most readily gained by means of a rotary converter.

The equipment which has been enumerated, or is necessary to carry out the experiments that have been mentioned, covers the essential requirements of any first-class undergraduate course in electrical engineering. There is much more work which must be carried out in the laboratory, such as testing the insulation resistance of wires, measuring the earth's magnetic force, accurately comparing standard resistances by divided wire bridge, etc., etc., but the equipment for this is found in that already enumerated or has its place among the apparatus of a well equipped physics department. There is much apparatus which is entirely unnecessary for both the physics and electrical engineering departments to possess. In fact, the work just mentioned, with the exception of insulation testing, really belongs in the instruction given by the professor of physics, and, as intimated earlier, it is well for the laboratories to be quite independent of each other. There is a vast amount of work carried on by undergraduates in the preparation of theses which is often in the nature of excellent investigation. Some of this requires special apparatus, and the extent to which it should be supplied from laboratory funds is an open question. Where the investigation does not require special apparatus, or where the work is in the nature of a test of commercial apparatus or an operating plant, the equipment that is required will nearly always be found among that supplied for the regular course, if the latter has been properly designed.

In determining the course of study to be pursued by the electrical engineering undergraduate, upon which the course of laboratory work must depend, it must, unfortunately, be remembered that he cannot confine his attention to electrical engineering during the whole time given to professional work in his course. He must gain an elementary but practical knowledge of thermodynamics and hydraulics, with an efficient knowledge of their application in steam and water power plants. He must also get a common-sense knowledge of the principles underlying the design, manufacture and selection of machinery. In fact, he must receive a good working knowledge of the problems of the mechanical engineer. Laboratory courses are likely to fail when not properly balanced, on account of a failure to educate the common-sense or judgment of students, and the students leave the college without having gained an all-round capacity for practical work and research which is necessary to put them in a fair way to become useful engineers. The knowledge of the electrical engineer must be based on the honest, well tried mechanical laws, and he must go into a study of all that will aid most in putting him in a way to make a thorough electrical engineer.

## Electricity in a Silver Mine.

The introduction of electrical apparatus into mines, to supersede steam or compressed air machines, either as auxiliary machinery or as the main power transmission scheme, upon which the entire operation of the mine must depend, is a gratifying feature of latter-day electrical development. An interesting installation has recently been made in a silver mine in the South, in which electrical apparatus plays a very important part.



ELECTRICITY IN A SILVER MINE.

The generating plant, situated at the mouth of the mine, consists of two engines 10½ and 16 by 12 inches. These are connected through friction clutches to a common shaft carrying a band wheel, and each engine operates one General Electric generator having 500 volts potential and 85 horse power output. The power house also contains a separate 9 by 9 inch McIntosh & Seymour high pressure engine operating an arc dynamo of 18 lights capacity and a 150 light incandescent machine. The pulley upon the common shaft is to be used to operate a third 85 horse power generator as soon as the extensions in the mine warrant the addition, while a 500 light alternating plant, which is also to be installed, will be run from a separate engine and will supply light for a town about two miles distant.

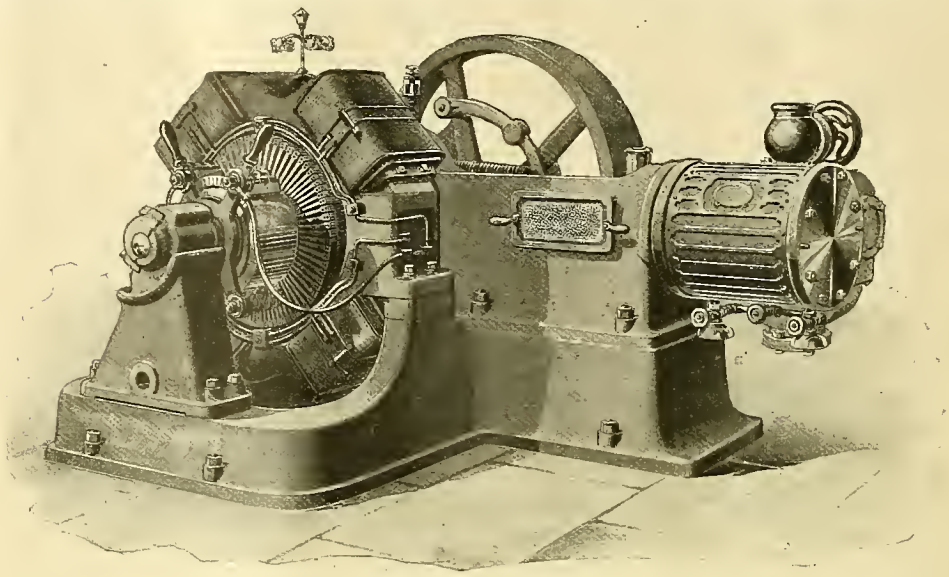
The current is carried from the power house to the tunnel of the mine and the various shafts over insulated copper wires. At shaft No. 1, 1,000 yards from the mouth of the mine, two hoists have been installed—one of the single drum type operated by a 16 horse power motor; the other of the double reel type. At a distance of about a mile from the station is shaft No. 3, which is equipped with a 25 horse power single drum hoist.

The electric double reel flat rope hoist in shaft No. 1, shown in the accompanying illustration, is probably the largest ever made, and has just been completed by the General Electric company. It nominally works in balance and has a capacity on each side of 5,000 pounds, the mean speed of the rope being 500 feet per minute. The motive power is furnished by a General Electric 125 horse power motor similar in size to the large ones used to propel the cars on the Intramural railway. The lower frame of this motor is provided with feet which allow of it being bolted to the bed plate of the hoist. The maximum demand on the motor will be about 80 horse power when the hoist is working singly. Under normal conditions—that is, when it is hoisting in balance—the demand will be about 50 horse power.

The hoist itself is extremely compact. The base, exclusive of the motor, is about 9¼ feet square, the width being increased by about 3 feet 4 inches by the addition of the motor. The height is about 7¼ feet above the foundations, the reel, however, extending a little below the level of the bed plate. The reel centers are 4 feet apart and have a capacity each of 1,000 feet of flat rope ⅜ inch by 3½ inches. The diameter of the naked reel is 3 feet; this when wound with the rope, is increased to 8 feet. On account of the direct relation between the working diameter of the reel and the weight of the rope unwound, which forms a considerable part of the load, the work done by the motor remains practically constant. When the load is started from the bottom of the mine the weight of the rope, about 2,500 pounds, is added, but it is being wound on an 18-inch radius. When the load nears the top only the ore and the skip are being lifted and the winding radius has increased to 48 inches. The average speed of the intermediate shaft is 200 revolutions per minute, which gives a starting speed to the rope at the bottom of the mine of 400 feet per minute and at the top 600 feet. The regulation of the hoist is therefore automatic.

The entire weight lifted from the bottom is about 5,500 pounds—2,000 pounds of ore, 1,000 pounds of skip and 2,500 pounds of rope. The reels are loose on the shaft, the hubs having brass bushings which may be readily renewed when worn. To each reel is cast on the side a polished clutch ring 5 feet in diameter, and upon this is fitted a band friction clutch, the ring keyed upon the shaft. This clutch is of improved type and forms one of the special features of this hoist. By its means the load may be started at any point without jerking, or the load may be released and allowed to come to rest when the hoist is running at full speed. The clutch has wooden faces which can easily be replaced when worn.

The brake rings are keyed to the reel and are 7 feet 6 inches in diameter, with an 8¼-inch face. Each is designed to allow for expansion of the brake when lowering, which heat may bring about. The reel shaft is of steel 6 inches in diameter, the journals being increased to 8 inches at the center and run in bearings babbitted and adjustable. The indicators on the front show the position of the cages. The weight of the hoist is about 3,200 pounds, and no part is so large but that it can be lowered into a mine the tunnel of which is 7 feet by 8 feet.



MATHER ENGINE-DYNAMO.

## Mather Engine-dynamo.

Nearly every manufacturer of electrical machinery is now prepared to furnish his customers with directly connected engines and generators, and the Mather Electric company of Manchester, Conn., which has recently attracted so much attention by pushing its new apparatus, is no exception to the rule. The illustration represents an improved Mather multipolar dynamo of 100 kilowatts directly coupled to a 150 horse power Ideal engine. These generators, which were described in detail in the WESTERN ELECTRICIAN of August 11th, are designed to be directly connected to any first-class type of engine adapted for this work, and are exceedingly compact. They are self-oiling, self-exciting, perfectly self-regulating, and, after being started, completely self-attendant. They are compound wound and equally well adapted for electric lighting, electric railway, or power purposes. As a special feature, it is worthy of remark that, after the brushes have once been adjusted, further change in their position is not necessary, no matter how sudden or how great may be the variations in the amount of current supplied by the generator. One of the tests to which these generators are subjected is to throw on and off heavy loads, always leaving the brushes in the same position. No sparking is caused even by a current in excess of the rated capacity of the machine, and it is practically impossible to distinguish by watching the brushes whether the generator is loaded or not.

## Clam Bake of the American Electrical Works.

The 16th annual clambake of the American Electrical Works took place on Saturday, August 25th, and proved one of the most notable picnics in the calendar of so many successful ones. In response to the cordial invitations issued by the popular host nearly two hundred gentlemen, many of them prominent in various departments of the electrical field, gathered at Haute Rieve, the headquarters of the Union Club down the beautiful Providence river. The weather was bright and breezy and of course the preliminary event of the day on arrival at the rendezvous was an onslaught on a lunch which was provided. When the fun began in earnest, everybody participated in the jolly good time, enjoyed the lively strains of an orchestra, tried putting the hammer, tested the galvanic and strikiog machines, etc. It goes without saying that rival base ball teams were speedily organized between Boston and Providence players. The Boston players won by a score of 26 to 6. The winning nine certainly had the advantage from the start, the brilliant playing of C. B. Burleigh, Tilton, T. Bibber and C. H. Tuckerman being something to see and remember, the two first mentioned with their left-hand pitching being irresistible.

A photographer, too, true to tradition, was on hand and took several groups of the party, after which the clambake was announced and a sumptuous feast it proved to be. Host Eugene F. Phillips occupied the seat of honor at the head of the center table. Charles W. Price acted as toastmaster and the postprandial exercises were made unusually brief, though they proved to be most enjoyable, the short addresses being listened to with marked attention and eliciting hearty applause.

The first speaker was the Hon. J. C. Wyman of Valley Falls, who delivered both an amusing and impressive address full of kindly sentiments and sparkling with anecdotes.

He was followed by Mr. Phillips, who in his genial way expressed the pleasure it gave his colleagues and himself year by year to welcome the representatives of the electrical business from all parts of the country, and trusted that all might be spared to participate in the years to come.

John I. Sabin, the veteran telephone manager of San Francisco, a bosom friend of Mr. Phillips and the original founder or suggester of these clambakes, was warmly received and spoke a few timely and encouraging words.

He was followed by A. F. Hibbard of Chicago, who entertained the company by singing an amusing little ditty about himself.

Mr. Brown of the Newburyport & Amesbury railroad, also had a few words to say and was followed by Frank R. Ridlon, who met with a cordial reception and delivered himself of a few chosen sentences which everyone appreciated.

After Mr. Ridlon had concluded the gymnastic exercises were resumed and the fun went on with but one slight accident. This occurred to genial and popular F. E. Donehoe, who represents the American Electrical Works in Chicago. In playing foot ball he slipped, straining one leg quite badly and putting an end to his exercises for the rest of the day. W. H. Sawyer, of course, was present, as quiet and gentlemanly and as cordial in his greetings to all as ever.

W. H. Hathaway, treasurer, and P. C. Ackerman, New York representatives of the company, were as unremitting as ever in their efforts to make everyone enjoy themselves, and they succeeded splendidly as they always do. One familiar face everyone missed and that was Mr. Remington, who is just recovering from a protracted spell of typhoid fever. Regrets were unanimous at his absence from the picnic. Before the company separated Eugene F. Phillips was voted a prince of good fellows, as everybody has long known, and "He's a Jolly Good Fellow" was sung in his honor.

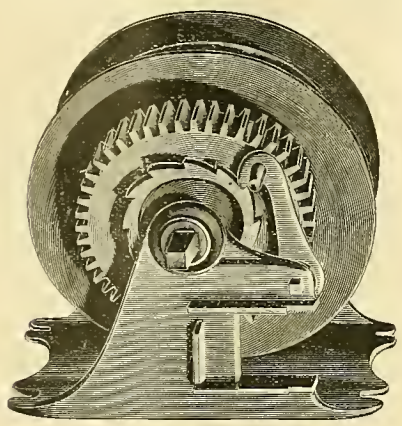
Altogether the 16th annual bake is entitled to rank as one of the very best and most enjoyable ever held, and that is saying a great deal when all have been so successful.

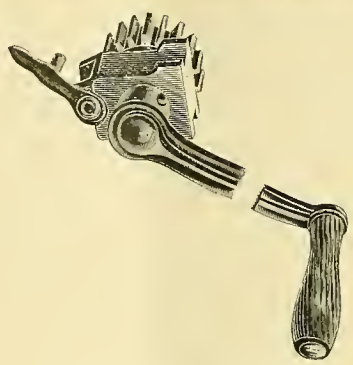
## Western Society of Engineers.

The Western Society of Engineers, Chicago, has issued a circular announcing that it now has a library of 1,400 volumes, besides pamphlets, drawings, etc., and has undertaken to make this the nucleus of a central technical library of reference, comprising civil, mechanical, mining, metallurgical, electrical, military, and marine engineering and allied subjects, the books to be made accessible under liberal rules to all who are interested in the study of these branches. A special fund has been established to take proper care of these books, and to purchase additions thereto, and the society pledges itself to promote continuously the increase and care of this library. The committee having in charge the subject is composed of O. Chanute, Fred. Davis, John Lundie, Henry M. Sperry, and Charles J. Roney, librarian.

## Cutter's Combination Windlass.

The gain in leverage makes a geared windlass popular with trimmers for raising arc lamps, but the difference in cost over that of a plain windlass has counted against a more widespread use of the former. The extra price being due to the cost of the gearing, the only feasible way for reducing it would consist in making one pinion do for a score or more of the devices. This is what Mr. Cutter has done in his new form, which consists of a geared windlass with a detachable pinion, the latter, together with its bearing box, being secured to the portable handle. The bearing box fits into a recess in the windlass frame and is easily locked in place by the hinged catch, thus making a geared device. What is more, the pinion itself is hollowed out to fit the shaft of the hoisting drum, so that the same handle will do in using the device as that employed for a plain windlass. The pinion handle with the bearing box is made as light as possible, so as to be easily carried by the trimmer, the result being a practical geared windlass that can be sold at a reasonable price. Other details and the general make-up of the device can be seen from the accompanying cuts. George Cutter of Chicago is the maker of this windlass.





CUTTER'S COMBINATION WINDLASS.

## Knapp Electrical Works Closed.

The Knapp Electrical Works at 271 and 273 Franklin street, Chicago, were closed by the sheriff on Monday, August 27th, on a judgment by confession for $29,834 in favor of Frederick M. Knapp. The judgment was given on a note executed September 18, 1893, payable on demand. Myron A. Knapp is the president of the company, and the money was advanced by his father. The company has done a large business, and it is said that the assets equal the liabilities, the closure being due to slow collections and a sudden demand on the company for money.

## Reported Consolidation.

A Baltimore press dispatch states that the Wenstrom Electric company has sold out to the Fort Wayne Electric corporation of Fort Wayne, Ind. This deal puts the Fort Wayne company in control of patents which, it is asserted, are being infringed by other electric manufacturers, and the Fort Wayne company will, it is said, immediately begin an active fight upon all who are reported as infringing its patents.

## Storage Battery Litigation.

Judge Green, in the United States Circuit Court for the District of New Jersey, handed down, on Monday, at Ironton, N. J., a decision denying the injunction asked for by the Consolidated and Brush companies against the Electric Storage Battery company of Philadelphia. This is regarded as an important victory for the chloride accumulator people.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, August 27.—The validity of the appointment of a receiver for an electric railway company has been passed upon in Brooklyn by Judge Lacombe of the United States Circuit Court. The case is entitled the Westinghouse Electric & Manufacturing company against the Flushing & College Point Railway company. On March 13th merchandise to the amount of $655 had been delivered by the complainant to the defendants, for which the railroad company would not pay. Suit was begun to recover the money, but on July 6th the road went into William H. Brown's hands as receiver. To set aside the receiver action was brought in the United States court, and Judge Lacombe sets aside the receiver, giving the following reasons: "The order appointing a receiver is vacated and set aside. If the complainant showed a default in payment of interest for three months I should appoint the same receiver in the second suit. But the averments are insufficient under the terms of the mortgage. The receiver will account and turn over the property and surplus cost to the corporation from which he took it."

The recent meeting of the American Association for the Advancement of Science in Brooklyn was very well attended and entirely successful, but hardly any of the papers bore upon electrical topics. Prof. B. W. Snow, of the University of Madison, described his experiments to determine the "Directed Velocity of the Particles in the Electric Arc." He concluded that this directed velocity was less than one mile per second.

The lot of the suburban electric railway company still continues to be far from happy. The Westchester Electric Railway company and the Union Railroad company at Mount Vernon, on July 31st, requested the common council to cancel their bonds to the city and to discharge their sureties, upon the claim that the requirements of the bond for the completion of the lines by June 1st had been fulfilled. The bond was for $25,000 and the requirements were that the companies should not only complete the work but should "so replace all macadamized or paved streets through which their line of railway may be constructed on or before the first day of December, 1893," or said bond would be forfeited, together with the privileges or franchises. The condition of some of the streets left unrepaired by the companies has been a cause for frequent complaint, and the railroad committee has reported adversely on the request for release, and instructed the corporation counsel to inform the railroad companies that, unless within twenty days the roadway is restored to good condition, action by the city will be begun against them to forfeit the bond.

The new cable lines are not proving an unmixed blessing. On Thursday forenoon the Third avenue line was stopped for nearly an hour. The trouble was caused by the parting of the cable near Chambers street. As soon as it broke it began to get badly mixed on the large drum in the Bayard street power house. The engines were stopped as soon as possible and scouts were sent out to find where the trouble was. The break was discovered near Chambers street and the ends were several hundred feet apart. Nearly an hour was occupied in hauling the cable out of the conduit, and then the cars were started all along the line.

W. F. O.

## Milwaukee, Wis.

MILWAUKEE, August 25.—One of the disputes in which the city and the Milwaukee Street Railway company are engaged is still furnishing interesting developments. It is the one growing out of the city's order directing the company to put concrete foundations under the ties in the streets which are being paved with asphalt. After the directors of the company had met in New York and after the advice of counsel to the effect that the company was not compelled to put in an inch of concrete under its tracks had been taken, General Manager Wyman wrote a letter to the mayor stating that the company would put concrete under the ties on Grand avenue, between the river and the alley between Third and Fourth streets, which is the portion of the avenue that was torn up at the time that the company's reply to the city was written. The object of the company in making the concession was to expedite the work that was in progress so as to make the avenue passable again as soon as possible. If the city wants concrete foundations under the tracks on any other part of Grand avenue or on any other street it will have to do the work itself and take the chances of collecting the money for the

work in the courts. Mayor Koch answered General Manager Wyman's letter by urging the company to rush the work on Grand avenue and by suggesting that the company also put concrete under its tracks on Wisconsin street, from the bridge to a point about 100 feet east of East Water street, a distance of about a block. The council, however, did not rescind the resolution requiring concrete under the tracks on all asphalt-paved streets, and until the resolution is rescinded the company will not do a stroke of work on Grand avenue.

The city will probably abandon the plan to compel the company to replace its present rails with grooved rails on streets that are being paved with asphalt. The claim of the city was that the present type of rail was injurious to asphalt pavement and that a change was really necessary. General Manager Wyman advanced the claim that the putting in of grooved rails would necessitate a large increase in the capacity of the power house. He quoted A. W. Wright, for many years engineer-in-chief of the North Side railroad of Chicago, in support of his position. Mr. Wyman said that by the present system it took thirty pounds of power to move a ton on the tracks at the required speed and that it took a great deal less power to operate cars on the old flat rails. With grooved rails in use he estimated that it would take sixty pounds of power to the ton. Mr. Wyman also asserted that the grooved rail fills up with dust and mud in summer and with snow and ice in winter, causing no end of trouble.

According to the management of the Milwaukee Street Railway company the withdrawal of the sale of commutation tickets has neither increased nor reduced the receipts. The receipts on Sunday before last, to be sure, were equal to the receipts for the corresponding Sunday in the previous year, but that the receipts held their own so well this year is due to the opening of new lines, especially the Lake park line. Some of the conductors report that their registers do not indicate such big figures as they did before the sale of commutation tickets was abolished. They add, however, that the difference is not so great as it was just after the sale of twenty-five tickets for $1 was stopped. In this connection it is an interesting fact that the two bus lines which were started in opposition to the electric cars have been abandoned.

At the last session of the common council the committee on railroads made a favorable report on the proposition to repeal the present ordinance requiring the conductors of street cars to leave their cars and ascertain whether the steam railroad crossings can be passed in safety. The repeal of this measure, it is said, has long been desired by the officials of the Milwaukee Street Railway company, although when the president of the old council introduced such a repealing ordinance the company strongly opposed it, for the reason, however, that that measure contained a provision which was considered a great hardship—a requirement for street railway watchmen at steam railroad crossings. To comply with such a measure, it was claimed at that time, would put the company to an expense of $18,000 annually. When the repealing ordinance came up for consideration last Monday it was claimed that the trolley rope was left unguarded when the conductor got off his car and went ahead to see that no train was approaching and that after the car had started again the pole, as a result of being left unguarded and of the car's being stopped, might slip from the wire and leave the car on the steam railroad tracks. On the other hand it was claimed that to neglect the precaution of stopping the car and going ahead to see whether the coast was clear would be as dangerous as anything could be. In reply to this argument it was stated that the steam railroad companies maintain watchmen at all the crossings, and that they afford sufficient protection. The council passed the repealing ordinance. When he introduced the ordinance to repeal the provision requiring conductors to leave their cars, Alderman Okershauser announced that he would introduce another measure requiring the street railway company to maintain watchmen at all the steam railway crossings, but he now says that he will not do anything of the kind.

A short time ago the Milwaukee Street Railway company contemplated the purchase of that portion of the Wauwatosa electric line between Western avenue and Twenty-seventh street. The two lines connect; in fact, the Milwaukee company operates the other road, but people who live on the Wauwatosa line west of Twenty-seventh street have to pay another fare or walk, and as Thirty-fifth street is inside the city limits the people interested are disposed to feel indignant. It is not likely now that anything will be done before the end of next season.

The common council of Fort Howard has granted a franchise to David McCartney to build an electric railway in that city, and it has also granted to him a franchise to put in an electric lighting system. Fort Howard, which is close to Green Bay, recently made a contract for electric light from that city, and many of the Fort Howard people were in favor of granting the street railway franchise to Green Ba urging that it would take both cities to support the electric light and electric railway enterprises. During the discussion of the franchise matters the annexation of Fort Howard and Green Bay was broached and met with a great deal of favor. The Green Bay car line, which is known as the Fox River electric railway, is six miles long and has been in operation since early in July. C. H. Holmes, formerly associated with Jackson I. Case of Racine, in both the Racine and the Green Bay lines, is now the owner of the Fox River road.

From Oshkosh comes the announcement that the inter-urban electric line is apparently farther away than ever before. J. K. Tillotson, who got the franchise for an electric railway in Oshkosh, which was to be part of the inter-urban system, is backed by ex-Senator Dorsey, and Dorsey, it is is also said, is execution-proof. Tillotson's bond for the carrying out of his franchise is pronounced invalid by the city attorney of Oshkosh. The bond is in the sum of $5,000, with ex-Senator Dorsey and Jesse M. Thomson of Chicago as sureties. The capital stock of the Oshkosh company was to be $1,000,000. The Oshkosh Street Railway company has seized the opportunity to apply for a franchise to convert its horse car line into an electric line, its franchise to be extended until 1930. Tillotson is bound to build eight miles of road by October or forfeit his franchise, and the council won't grant another franchise until that time has elapsed.

Alderman Devos of this city is tired of having the street cars stopped every time there is a fire on any of the principal streets. He purposes that a bridge-like arrangement be used so that the cars may pass over the hose without injuring it. It is his idea to have the bridge made of iron, with room for ten lines of hose to pass under it.

The Peterson Electric Conduit Railway Construction company, with a capital of $500,000, has been incorporated by A. E. Smith, William Meyst and H. Samuel Esch. It is claimed that the Peterson electric conduit system, the invention of H. Peterson of this city, will do away with all objectionable features heretofore experienced by the use of the overhead trolley system. The Peterson system is so constructed, it is claimed, that it is entirely free from all accumulations of dirt and moisture, and that no moisture can make its way into the compartment containing the electric conductors, even if the street is flooded.

The Peterson system also does away with the corrosion of water and gas pipes, telephone cables and other metallic property buried in the ground, which is caused by electrolysis from the ground return current of the overhead system. It is stated that it costs 40 per cent. less to maintain the underground system than the overhead trolley system, while the direct saving in power by the use of the underground system, with complete metallic circuit, is from 20 to 25 per cent. so that the solution of the electrolytic question means a great saving and reduction in operating expenses. C.

## Washington, D. C.

WASHINGTON, D. C., August 25.—United States Consul Wallace S. Jones at Rome has transmitted to the State Department an interesting report concerning the electric lighting system of the Eternal City. The power that goes to furnish the illumination is transmitted a distance of eighteen miles, from the Cascades of the Teverone at Tivoli, across the Roman campagna, to a distributing station at Porta Pia, on the outskirts of Rome.

The present electric light system of Rome was established in July, 1892, and has been in successful operation ever since. Mr. Jones says that Rome is the first city in the world to be lighted by electricity brought from such a long distance. His report gives a detailed description of the plant and apparatus, by which 2,000 horse power is transmitted a distance of eighteen miles, together with sketches of the switchboard at Tivoli and the distributing board at Porta Pia.

The power is generated at the fall of the river Teverone, or Anio, at Tivoli. The water has a total fall of 110 meters, and the power at hand is much more than sufficient for the generation and transmission of electric energy to the Roman capital. Separate chapers of the report are devoted to the power house at Tivoli, where the current is produced, the transforming and distributing station at Porta Pia and the setting up of the lights in the city. Nine pipes are used in carrying the water to as many turbines in the station house, where a fall of about fifty meters is utilized.

Special arrangements are made for the decantation of the water that drives the governors of the turbines, and for the automatic closing of the necessary derivation pipes leading from the main supply pipe. The turbines are of the Giraud type, with horizontal and differential axes. There are three groups of three machines each. Two large turbines are coupled directly to two Zipernowsky alternators, and between them is a smaller machine that drives a direct current dynamo which moves two lateral alternators. This system is duplicated in the other turbines. The principal turbines are of 350 horse power, and make 170 revolutions a minute, normal speed. The water wheel is two meters in diameter. The distributor consists of a cylinder with six small holes in the bottom, and five series of three cocks each in the top. The small turbines are of fifty horse power, and have a normal speed of 375 revolutions a minute.

The alternating current dynamos are directly coupled to the turbines. The machines, although of the usual Zipernowsky type, develop a difference of potential of more than 5,000 volts, and require exceptional insulation. The terminals of the high potential dynamos are situated in the lower part of the armature. They are mounted on separate disks of porcelain on two posts, one of ebonite and the other of paraffined wood.

The plant can be divided into three sections, each comprising two alternators and one exciter. Consequently there are three grooves that carry the entire system to the switchboard. Each groove incloses twelve conductors, four conveying the primary current of two distinct alternators, and four the respective exciting currents; two conveying currents from the exciting dynamos, and two others conveying the exciting current of the exciter. This makes three sets of twelve conductors each represented on the swithboard. They are completely insulated from each other. The switchboard is of wood, and is 20.50 meters long by 3.80 meters high. It stands sixty centimeters from the wall, so that there is ample space to keep clean the conductors that run along its back.

The line of transmission from Tivoli to Porta Pia is 24,858 meters in length. It follows the Roman aqueduct, which runs in a straight line between the two places. Where the line crosses the Rome-Sulmone railroad and the telegraph wires the poles are high enough to leave the lowest cable at 9.50 meters above the ground. A metallic net is stretched between the poles, and extends across the railroad tracks to prevent the cables from falling to the ground in case of accident. At this point the telegraph wires are underground.

The same precautions are taken at the points where the line crosses the river Aino and the railroad near Porta Pia. About half way between Tivoli and Rome, at a point known as the Campannacce, a small stone house has been erected, which serves as quarters for the men who watch the cables, as a depot for stores, as a point of communication between the two extreme stations, as a center of electric measurements, and finally as an interrupting point of the line.

The eight cables composing the line pass through an upper room in a tower that surmounts this house, and are there united two and two. Four wires pass out of the house on the opposite side through four insulators. The supporting poles are made of two double T irons 9 meters high. The four copper cables that transmit the current are held up by insulators. As a rule, each pole carries eight insulators, with eight conductors, and is 9.50 meters high. The mean distance between the poles is 35 meters, except at railroad crossings and at the river. There are 707 of these poles. The four cables are respectively 9.30, 8.70, 8.10 and 7.50 meters above the ground. High insulation has been obtained by the use of a well devised porcelain insulator, with oil cup. The conductivity of the copper wire was found by experiments to be 99 per cent. that of chemically pure copper. The wires are 2.60 mm. in diameter and each cable is composed of nineteen such wires. At a temperature of 0° the cable presents a mean resistance of 3,750 ohms.

The electric current generated at Tivoli is received in a small building at Porta Pia, where it is ingeniously transformed from a high potential to a lesser potential. The potential, however, is not less than 2,000 volts, and feeds twelve concentric Siemens cables, which run through the principal streets of the city of Rome. All the electric apparatus is placed on the ground floor of the building, and thirty-two transformers are located in one room. In another room are the distributing switches and the automatic regulators. The disposition of the apparatus is entirely subordinate to the system to be supplied, and circuits for arc lamps, as well as derivative circuits for use of private parties, leave this building. These circuits are formed by concentric Siemens cables of 12 millimeters in diameter, each of which is fed directly by the secondary of a transformer at this building.

The isolated plants in the city that connect with the derivative circuits are not fed directly by the 2,000 volt current derived from the secondaries of a special battery of transformers, but by that current reduced to 50 or 100 volts by means of other transformers located near the place of

consumption. The communication between these plants and Porta Pia is had by means of other similar Siemens cables of 200 or 220 millimeters in diameter. By an ingenious mechanical arrangement, it is possible, at the Tivoli station, to secure a constant potential throughout the entire line.

Bernard R. Green, superintendent and engineer of the construction of the new Congressional Library, Washington, D. C., is inviting proposals, until September 10, for furnishing three 125 volt directly coupled dynamos and engines for the Library of Congress. The following are the specifications which must be complied with by prospective bidders:

There will be three direct current multipolar dynamos coupled directly to high speed engines, each to have a capacity of 100 kilowatts at 125 volts. The dynamos will be compound wound. The speed of the dynamos shall be between the limits of 200 and 250 revolutions per minute. Each proposal must be accompanied by drawings showing the general construction and dimensions of the dynamos. Detailed drawings and fuller information as to the construction of the various parts of both dynamos and engines must also be furnished by the bidders if called for, but the drawings and descriptions submitted with the bid must be reasonably complete. A. I. P.

## PERSONAL.

M. E. Baird of the Eddy Electric Manufacturing company was in Chicago last week.

A. B. Field, for several years a salesman with the General Electric company, has accepted a position with the Iona Manufacturing company, 336 Congress street, Boston. Mr. Field has a large circle of friends in the trade.

## ELECTRIC LIGHTING.

The Grand Island, Neb., Light & Power company has just obtained a franchise from the village authorities. Customers for 1,000 16 candle power lights have already been secured, and the machinery and line equipment is being purchased. The plant must be in operation by November 25th.

An assignment has been made by the Northwestern Electric Light & Power company, whose plant is located at 60 and 62 Custom House place, Chicago. William L. Abbott was named as assignee. The assets are estimated at $66,450, and the liabilities at $66,866.79. The corporation was organized in 1892 with a capital stock of $100,000 for the purpose of supplying electric light and power to private consumers. The president is F. W. Bryson. Attorney Percy L. Shuman, the secretary, ascribes the failure to competition on the part of the Chicago Edison company. The creditors of the concern, it is said, are few in number, and it is not the present intention of the assignee to carry on the business.

## ELECTRIC RAILWAYS.

The Chicago City Railway company has notified the department of public works that it will at once commence the work of putting in iron poles for the trolley system on Halsted street from Sixty-ninth to Root, on Root to Wentworth, on Wentworth to Thirty-ninth, and Thirty-ninth to State street.

An electric brake has been in use upon a car of the Suburban Railroad company of St. Louis for several months. Its construction is a hollow magnet, made of coiled copper wire; in the middle, and free to move lengthwise, are two pieces of soft iron, the opposite ends of which are connected with the brake levers. When the coiled wire is energized the two soft iron cores are moved toward each other and the brakes are applied. The brakes may be applied with full force at first and let off gradually as the car stops. The brake is manufactured by the St. Louis Electric Brake company.

It is proposed to construct an electric tramway from Budapest by way of Newpest to Rakos-Palota, and the subject is now under the consideration of the minister of commerce. At Pressburg an electric line is about to be built both for goods and passenger traffic. Concerning the projected underground electric railway in Budapest, it appears that the minister of commerce has approved the project. A telegram from Vienna recently, states that the Hungarian minister of commerce has granted a concession for the construction of an underground electric railway in Pest. This line will be two miles in length, and will pass from Giselaplatz to the Thiergarten. It will be the first electric underground railway in continental Europe. It is to be opened April 1, 1896.

It is announced that the Compagnie des Chemins de Fer de l'Ouest, as a result of the experiments made with the Heilmann ocomotive, has just ordered two new locomotives from the Société de Traction Electrique, which controls the Heilmann patents. Certain improvements and modifications suggested by the trials of the original engine will be embodied in the new locomotives with a view to the construction of a definite type. The steam-engine chosen as best fulfilling the working conditions is the Willans. It is further announced that Messrs. Willans and Robinson through their French agent, A. H. Crozier, have been commissioned to deliver by January or February next, two steam-engines, each 1,500 horse power. It is intended to conduct experiments with the new locomotives next May, and if the results are conclusive it is reported that the Heilmann locomotive will be definitely adopted.

The Philadelphia People's Traction company's first order of 300 cars, most of which have been delivered by the builder, the St. Louis Car company and the Lamokin Car company, are being equipped with the General Electric and Sperry motors, 150 sets of each, says the *Ledger*. The General Electric equipment is two 30 horse power motors on each car. The handsome summer cars from the St. Louis Car company are being equipped with the Sperry motor and an electric brake which is giving general satisfaction. There is one motor of 40 horse power to each car, swung on springs between the two axles. Instead of a crank, the controller for the Sperry motor is operated by a lever moving crossways of the car. The controller box is placed as usual close to the dasher and occupies very little space. The current is thrown on and the car started by moving the lever to the left. There is an attachment for reversing the motor. The electric brake is the most interesting feature of the equipment of the cars which have the Sperry motor. It is operated by the controller lever, and is entirely distinct from the hand brake, which need not be used except in emergencies.

Rochester and Syracuse capitalists have come into control of Capt. Lina Beecher's single track railroad, now in process of construction in Orleans county N. Y. between Waterport and Lakeside, and the line will be pushed rapidly to completion. When Capt. Beecher's company was incorporated, it was with an authorized capital stock of $600,000, but it was deemed wise by the managers to issue at the present time but $100,000 of stock. The first $40,000 was taken by Capt. Beecher and his associates and wealthy farmers in Orleans and Genesee counties, it being the plan to ultimately extend the road through to Batavia. Work was commenced, although it was plain that more stock must be issued to pay the expense of construction. Capt. Beecher's original plan was to extend the road from Batavia to Oak Orchard harbor by way of Albion. The scheme met with favor, and this route would have been chosen had not some of the stockholders withdrawn and started a new company. The new company planned a standard guage steam road. Surveys were made, but within a few weeks it has been rumored that the new company had fallen through and that the rival road would not be built. Work on Capt. Beecher's single track trestle road has progressed steadily, and it hoped that the first cars will be run September 15th or thereabouts. The contracts for the dynamos and other electric appliances have been let, and the power house at Waterport will be ready for operation in about two weeks. Six hundred feet of track will be laid, and after it has been proven to the stockholders that the road is a success, the remaining three miles to Lakeside will be constructed. The cars will be running to Lakeside by the first of December, it is promised. Next year it is proposed to push the road through to Batavia. The officers of the company are: President, D. D. Bromley; vice-president and general manager, Capt. Lina Beecher; secretary and treasurer, Edwin Charles Long; assistant secretary and treasurer, W. T. Bromley.

## TELEPHONE.

Patrick Egan, director and general counsel for the Harrison Telephone company, who visited Chicago recently, is now in New York. If the company puts in a plant in Chicago, it is said, it will lay its conduits under the franchise granted February 29, 1892, to the Chicago Power Supply & Smoke Abating company, more commonly known as the Bacon Compressed Air Supply company. Mr. Egan has not made himself known to the Chicago city authorities in behalf of the new telephone company. Some doubt is expressed as to whether the Bacon compressed air franchise would be of great service to a competing telephone concern.

According to a financial journal the stock of the Mexican Telephone company is advancing, and with the extension of the system the value of the plant will naturally increase. Last year the company earned in Mexican money about $57,000. of which about $7,000 was credited to the supply department. At the same rate of exchange this $57,000 was equivalent to about $30,000 of American money. The company has this year given up the supply business, but it expects to fully offset the loss from this source by an increase in its telephone business. Earnings for the present year are expected to aggregate $60,000 in Mexican money, which should exchange for about $30,000 of American money. The company claims that, if exchange was at the figures quoted before the great disturbance in silver occurred, it would, with its increased business, be in a position to afford the stockholders considerable encouragement. The company has no bonds outstanding, and all that is left after paying operating expenses will go the stockholders. The company has no way of raising money for needed improvements except to draw on earnings. It costs about $60 to equip every new subscriber. At this stage of the company's development it is necessary to draw continuously on earnings to extend the service.

## LEGAL DECISIONS.

The Supreme Court of Vermont held in the case of Rugg against the Commercial Union Telegraph company, that where it does not appear in erecting a telegraph line along a highway that it would be inexpedient to erect it without inconvenience in traveling, or making repairs of the highway, nor that it was erected along the streets of a village, or in front of or near a dwelling, nor that it became necessary to cut or injure trees, the authorities have no power to award damages to an abutting landowner under the statute providing that the authorities of a town shall appraise the damage caused by the erection of a telegraph line.

## POWER TRANSMISSION.

A charter has been granted to the Great Kanawha Water Power & Electrical company. It will utilize the water power of Great Falls in Ohio, and will supply electrical power to the Kanawha valley.

The Chambly Manufacturing company of Montreal, Que., is inviting bids for the development of the water power at the Chambly Rapids of the Richelieu river, the outlet of Lake Champlain, and its conversion into electricity and transmission to the city of Montreal, a distance of about 18 miles. The company has secured control of the entire water power at the rapids, which have a fall of 62 feet in a distance of four miles. To fully utilize the power a series of dams would have to be built across the river, but at present the building of one only is contemplated. According to the company's engineers, this would give a head of from 26 to 27 feet, and yield about 27,000 horse power at low water. Some 15,000 horse power would probably be delivered in Montreal, of which about 3,000 horse power would be used for arc lighting, 6,000 horse power for incandescent lighting, and 6,000 for power purposes.

## MISCELLANEOUS.

The Western Electric Base Ball club succeeded in hammering out a victory in the ninth inning from the University of Chicago nine on Saturday afternoon. Up to that time the game was of the see-saw order, but in the last inning the Electrics took a sudden fancy to Stagg's curves and made hits enough to tally four men, making the score 15 to 13 in the electricians' favor. The features of the game were the "slugging" on both sides and Meehan's work at short. The batteries were Stagg and Tike for the 'Varsity and Kelly and Stock for the visitors.

A severe electrical storm in St. Louis recently deprived many aquariums, both in residences and show windows, of their silver and gold fish. Thunder and lightning are judged by old fishermen and proprietors of animal stores to be the cause of the death of the fish, which were found floating on their backs for several mornings after the electric storm. A St. Louis electrician gives it as his opinion that the concussion of the thunder breaks the air chambers which, by compression, cause the fish to sink and, by expansion, to rise to the surface.

## TRADE NEWS.

The Washington Electric company, 207 South Canal street, Chicago, has done a good business during the last week. The company has found it necessary to increase its working force in order to keep up with its orders for focusing lamps, stage dimmers, rheostats and annunciators.

The new power station for the Hartford Street Railway company, at Hartford, Conn., will be designed and built by the Berlin Iron Bridge company, of East Berlin, Conn. It will be 66 feet wide and 233 feet in length, with a steel frame covered with the Berlin Iron Bridge company's patent anti-condensation corrugated iron covering.

## BUSINESS.

The Berlin Iron Bridge company, of East Berlin, Conn., has received the contract for the new plant of the Fairfield Copper company, at Monroe, Conn. The plant will be entirely of iron and steel, no woodwork being used about the construction.

The growing popularity of the Packard Mogul is something to which the Electric Appliance company, general western agent, points with considerable pride. The demand for this lamp has been increasing rapidly and steadily from the first, and almost every expectation as to its wide field of future usefulness is being realized. It is now coming into quite general use for street lighting, for which work it possesses many advantages.

A. R. Jennings, 317 Mermod-Jaccaird building, St. Louis, Mo., broker in electrical goods of every description, is handling a full line of supplies, including arc lamps for direct and alternating currents, slate sockets, switches, lamps, mica insulators, cleats, transformers, fuse blocks, cut-outs, rosettes, etc. Mr. Jennings represents manufacturers direct and therefore is able to quote special prices.

The Mather Electric company of Manchester, Conn., reports the closing of an important contract with the Phelps Publishing company of Springfield, Mass., for the complete equipment of the latter's extensive plant with electric power. The new slow-speed motors of the Mather company will be used throughout, in sizes from 20 to 50 horse power, the power being supplied from the Springfield station of the United Electric Light company. This installation, when completed, will be one of the largest of its kind in New England. The Mather company is now represented on the Pacific Coast by the following named contractors for its apparatus: H. B. Gregory & Co., Portland, Oregon; Will & Finck company, San Francisco, Cal.; Machinery Supply company, Los Angeles, Cal.

The Wallace Electric company of Chicago has added to its present line of specialties a complete line of arc lamps adapted for almost every purpose. The company is western agent for the Electric Construction & Supply company of New York, and the arc lamps manufactured by this company need no introduction, as they are well known. The Wallace company will carry a complete stock in Chicago, including alternating and direct current lamps, double carbon and twin lamps, ornamental and plain lamps, railway lamps, search lamps, theatrical and focusing lamps and projectors. The house goods department of the Wallace company, although recently inaugurated, is making quite a record for itself. The Eureka iron box bell, handled by this company, will be recognized in a new dress, and, with its double adjustment features, is excelled by none. The Ajax dry battery, the Diamond carbon battery and Excelsior Disque La Clanche battery are all favorites. The company reports that its new illustrated pamphlet will soon be ready for distribution.

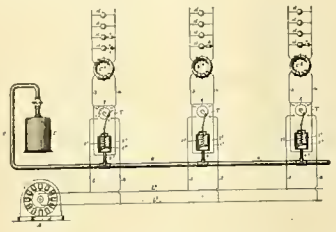
# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued August 21, 1894.*

524,706. Electric Light Support. W. H. Connell, Wilmington, Del. Application filed January 24, 1894.

The object of the invention is to provide a support which, when swung around on the bracket to which it is pivoted, will close a circuit leading to the lamp, and to so arrange the connections that the circuit can be completed and the lamp lighted at any desired position, and also to arrange a series of lamps so that any desired number of them may be lighted by a single movement of the lamp support.

524,710. Method of Producing Electrodes. Desmond Gerald Fitz Gerald, London, Eng. Application filed November 7, 1893.



NO. 524,749.

Three processes of treatment of the elements for voltaic cells are described, the advantage of the method, it is claimed, being due to the fact that the set product is more homogeneous and more porous, and at the same time is stronger, and especially that it is capable of being "formed" or converted into peroxide of lead in a very much shorter time and with a very much smaller expenditure of electrical energy than has hitherto been necessary when the product has been caused to "set" by means of any salt heretofore used.

524,711. Printing Telegraph. R. A. Fowden, Philadelphia, Pa. Application filed December 22, 1893.

In the arrangement described by the inventor, it is claimed, the system has been greatly simplified and the number of parts reduced without impairing the efficiency.

524,717. Safety Switch for High Potential Circuits. Samuel Harris, Cleveland, O. Application filed June 14, 1894.

Special attention has been given in designing this switch to prevent burning out when the switch is being thrown.

The principal claim reads:

The combination of the two-part insulated case, a disk of non-conducting material extending across the upper part thereof, a single contact block on each side of said disk at diametrically opposite points with connections to the circuit, holding blocks opposite the contact blocks and insulated from the circuit, a stem extending through the disk and through the top of the case, and having on each side of the disk and diametrically opposed a contact arm adapted to make circuit with the contact block, said contact arms being conductively connected and rotating in planes parallel to the disk, and said stem and arms being insulated, except at the contact points, and an index and handle outside the case for operating the switch.

524,749. System of Electrical Distribution. George Westinghouse, Jr., Pittsburg, Pa. Application filed June 16, 1890.

It is provided in this arrangement to cut certain converters out of circuit when idle or when no work is being done in their secondary circuits. At certain hours in the day the lights in certain localities are uniformly extinguished. The converters supplying these lights may, therefore, be all cut out of circuit during such times. In the accompanying illustration *A* represents any suitable source of alternating, intermittent or pulsatory electric currents, and $L' L^2$ its main line conductors. Converters $C' C^2 C^3$ are illustrated as having their primaries adapted to be connected in multiple between the lines $L' L^2$. The secondary coils of these converters supply translating devices *d*, which may be cut into and out of circuit by means of the switches *s*, for instance. A suitable source of compressed air is represented at *E*. A pipe *e* leads from this source into the immediate vicinity of the several converters or to points where their circuits are derived from the main line conductors $L' L^2$. Connections with any converters, *C'* for instance, are completed through a circuit-controlling device *t*, the position of which, with reference to its contact points, is controlled by the pressure exerted upon a piston or plate $t'$, moving within a chamber $t^2$. A spring $t^3$ normally tends to force this piston in such direction as to cause the switch *t* to break the connections between the conductors *1* and *2* leading from the main line conductors $L' L^2$, and conductors *3* and *4* leading to the converter. This spring may be adjusted to respond to any required degree of pressure exerted upon the opposite side of the piston. A pipe $e'$ leads from the pipe *e* to each device *T*.

524,758. Electric Railway Signal. Lawrence Dornberger, Highland Falls, N. Y. Application filed April 17, 1894.

This invention has for its object to effect certain improvements by which a signal arm may be automatically operated by the movement of passing trains to indicate "safety" or "danger" in the customary manner.

524,773. Electric Railway Supply System. Malone Wheless, Washington, D. C. Application filed July 7, 1894.

It is proposed to dispense with overhead and underground trolley and the expensive construction incident to carrying conductors in an open subway or conduit. Instead, however, it is proposed to use contact pins which are the terminal of feeders from the main cable, and which are placed at intervals in the track or roadway upon which the car runs, these contacts being successively met by a shoe on the car through which the current is led to the motor. Each feeder connection has in it normally open contacts which are controlled by a pick-up magnet located at that point, this pick-up magnet, although located in the track, being energized from a source of electrical supply on the car through suitable circuit connections. In the cut is shown an insulated lead covered cable *D* laid the entire length of the route in a terra cotta or other suitable main, enters and passes through the boxes, the joints between it and the boxes being sealed and water-proof. From the cable is led off a feeder *n* for each box. This feeder is attached to a metallic holder *2*, which clamps a carbon block *3*, the latter being held securely to a slate or other non-conducting slab *4* by a bolt *5*. On the opposite end of the slab is a similar carbon contact block *6* mounted and fastened to the slab in the same way, and from the latter leads a wire *7* to the external coil *S* on the soft iron core *10* of the pick-up magnet co-operating at its other end by wire *11* with the track terminal *A*. The pick-up magnet is secured to a slate or other non-conducting slab *12* attached to the under side of the top or cover of the box. It has two insulated coils, the external coil *S* already referred to and an internal coil *9*. The internal coil is connected at one end to a wire *1*, which leads to the terminal *A'* and at its other end it communicates with wire *11*. The pins or track terminals *A A'* which are insulated from the box project up through the box cover or top and rest by their heads upon a concrete or other suitable non-conducting base. These terminals are intended to co-operate with the two shoes *r r'* with which the car is provided—one for each terminal. The energizing circuit for the pick-up magnet is completed through terminals *A A'* and the feeder or motor circuit is completed through the terminal *A*.

524,785. Controller for Electric Cars. Marion Baker Monroe, New Orleans, La. Application filed February 28, 1894.

The principal feature in this invention is to provide an electric car with the mechanism by which the brakes may be applied by the same means and at the same time that the electric current is cut off, so as to enable a motorman to make a quick stop without the liability of damaging any of the parts.

524,789. Electric Subway System. John C. Reilly, Brooklyn, N. Y. Application filed May 28, 1894.

By this plan means are provided to cheaply and expeditiously furnish any subscriber with electrical connection for any period of time, while no idle conductors are allowed to remain in position in the subway, and the desired electrical connection or disconnection may be made in any kind of weather or at any time of year, whether the ground be frozen or not, and without disturbing the surface of the earth or the pavement.

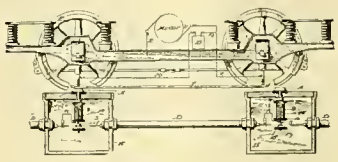
524,793. Commutator Cylinder. Alton J. Shaw, Muskegon, Mich. Application filed June 7, 1894.

In the construction of commutator cylinders of electric generators and motors provision is made to compensate for or take up the expansion and contraction of its bars.

524,808. Circuit Controller. Edward J. McEvoy, New York, N. Y. Application filed July 7, 1894.

The first claim made by the inventor is for the combination to form a circuit controller, of a box or casing, a pair of terminals provided with binding posts, a rotatable rock shaft mounted in said box or casing, a yoke of conducting material carried by said shaft, a spring, the operation of which is to hold the yoke out of contact with the terminals, an operating shaft journaled within the casing and projecting therefrom, a cam upon and rotating with said operating shaft and a cam toe springing from the rock shaft and bearing upon the cam.

524,823. Electric Railway Car. J. C. Henry, Westfield, N. J. Application filed August 22, 1892.



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The working parts of the motor are placed within sight and reach of the motorman without interfering with the passengers' seats or occupying the room devoted to them. A long wheel base is secured, with no danger of cramping on curves, and the number of wheels and other parts are reduced, thereby simplifying and reducing the cost of the car.

524,843. Separator for Battery Plates. William L. Silvey, Dayton, O. Application filed February 12, 1894.

This device is constructed of spruce pine, poplar or other soft wood or material, reduced to a thoroughly impalpable mass by boiling, grinding and treating with acids and lime and water until every particle of the original structure has been reduced. It is next washed and rolled into board of the required thickness for the purpose, moisture being removed by heated calendering rolls. This board is now cut into shapes to correspond with the general outlines of the battery plates. Sheets of textile material may be used, providing the interstices between the threads are sufficiently close to allow the passage of the electrolyte and not the particles of worn electrode, and after being treated so as to preserve the plates in the electrolyte.

524,844. Electrical Testing Switch. H. Smith, Buffalo, N. Y. Application filed March 29, 1894.

The principal object of this invention, which is a device for locating grounds on fire alarm, police or call box lines, is to enable the operator, when trouble has been found upon the line, to readily locate it, and also enable him to readily close the circuit between the stations where the trouble has occurred.

524,845. Automatic Regulator for Dynamos. Henry D. Symmes, St. Catharines, Ont. Application filed June 6, 1894.

The device consists essentially of one or more solenoids through which the current in the main circuit passes, and one or more resistance circuits with contacts arranged as a shunt to the main circuit, each solenoid being adapted to break contact in the corresponding resistance circuit when a current of more than a predetermined number of amperes passes through th main circuit.

524,850. Insulator. C. N. Hammond, Boston, Mass. Application filed December 18, 1893.

Claim 1 reads:

An insulator comprising a mass or block of suitable material formed with a wire-receiving groove or depression and holes on opposite sides of such grooves or depression, a wire-retainer having a stem which is placed in one of said holes and hook-shaped head which overlies the wire in the groove or depression, and has its down-turned point entered into the other of the said holes, and a securing device applied to the stem.

524,852. Motor Generator. John C. Henry, Westfield, N. J. Application filed January 28, 1893.

The subject of the invention is a compact and simple motor generator, having its armature shafts connected by flexible shafting, making the motor generator of special utility, it is believed, in electric railways systems such as described in the application by the same inventor, serial No. 415,499, dated December 18, 1891, of which the present application is a division.

524,881. Electric Heater. Tapley W. Young, Washington, D. C. Application filed October 6, 1893.

This electric heater is designed for use in oil wells, and is intended to melt the hardened paraffine in the fissures of the rock, thereby removing the chief source of obstruction to the flow of the oil.

524,884. Commutator for Dynamo-electric Machines. G. F. Card, Covington, Ky. Application filed January 8, 1894.

It is proposed to overcome the difficulty that has been experienced in mounting the commutator on the shaft of the armature, so as to prevent the oil on the shaft from coming in contact with the segments of the commutator.

524,911. Apparatus for Transforming Continuous Electric Currents Into Alternating Currents. F. S. F. Schneider, Fulda, Germany. Application filed March 20, 1894.

The inventor makes the following claim among others:

In a transformer, the combination with two electro-magnets included in two primary circuits and a battery common to both circuits, of a rocking armature carrying contacts operating to alternately make and break said circuits, and a secondary conductor having its terminals connected with the primary circuits between the magnets and the circuit breakers.

524,947. Electric Danger Signal for Railways. A. B. Murray, San Rafael, Cal. Application filed March 17, 1893.

By the employment of this device it is proposed to give a signal to the engineer at a point of sufficient distance, of an open switch, of an open drawbridge, of a bridge on fire or destroyed, or of any danger of a similar character of which an engineer often has no warning until too late.

524,953. Electric Meter. Carl Daniel Raab, Kaiserslantern, Germany. Application filed January 18, 1894.

It is believed that the improvements proposed will remove the inaccuracies in the proportional relation between the power of the current and the number of revolutions, which is caused by an unforeseen and unaccountable stopping of the air between the armature and the damping plates.

524,973. Fire Alarm System. J. W. White, Providence, R. I. Application filed May 28, 1894.

Comprised in this arrangement is a thermostat having three electrodes, with two circuits, one of which is closed and the other open, the closed circuit and the open circuit having one electrode of the thermostat in common, and both circuits being provided with suitable translating devices, but the closed circuit being through a loop about all the thermostats, with such a resistance in that loop that the normal current in the closed circuit is small and serves simply to move the needle or pointer of its translating device to an intermediate position, indicating that the apparatus is in order.

524,976. Electric Railway Supply System. J. F. Cummings, Detroit, Mich. Application filed September 22, 1892.

The objects of this improvement are to avoid the dangers and the disturbances in the traffic arising from the short-circuiting of conductors with the earth or other conductors, and consists in the peculiar arrangement and construction of the conductors in combination with permanent means for testing them in a manner to immediately detect and locate any fault, whereby no time is lost in searching and repairing, while at the same time the system may be kept in running order to permit traffic to go on uninterruptedly.

524,977. Underground Conduit for Electrical Conductors. J. F. Cummings, Detroit, Mich. Application filed January 17, 1893.

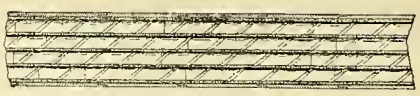
The special feature claimed is the peculiar construction of the ducts in which the wires are to be carried, being made of semi-cylindrical sections arranged to form a tube to break joints and secured together by a binding tape bound spirally about. One or more of these ducts are arranged in a conduit or casing, then a filling of non-conducting material is placed around them and the cover is placed upon the conduit. The invention further consists in the peculiar construction, arrangement and combination of the parts. A horizontal section of this conduit is shown in the accompanying illustration.

524,980. Electric Wire Coupling. C. K. Hall and W. B. Lillard, New Orleans, La. Application filed December 8, 1893.

This invention is intended especially for coupling wires from one car to another.

524,981. Electric Arc Lamp. Rudolf H. Jahr, Opladen, Germany. Application filed April 9, 1894.

The lamps to which these improvements are particularly applicable belong to that class in which the two carbon holders are attached to the two ends of a chain or cord guided over pulleys or rollers and the carbons are caused to approach each other, owing to the greater weight of the upper carbon holder. According to this invention the regulating device is so constructed that the shortening of the electric arc to the normal length or the feed of the carbons, the lengthening of the arc



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when shortened during the burning away of the carbons—as by the falling of small particles from the upper carbon onto the lower one—as well as the primary striking of the arc when the carbons are in contact, are effected by horizontal oscillations of a single armature which is placed under the influence of two magnetic poles of like name dependent for their respective magnetic strength on the fluctuations of the electric arc, so that, according to the changing strength of the magnets, the armature is caused to oscillate to one side or to the other. In oscillating to one side the armature causes the upper carbon holder to be released, whereby the latter is permitted to descend in order to shorten the arc to normal length: in oscillating to the other side the armature causes the upper carbon holder to be stopped again, while it allows the under carbon holder to descend in order to compensate for shortening of the arc or to start the arc when the carbons are in contact on the lamp being put in the circuit.

524,983. Apparatus for Supplying Electricity for Light and Power Purposes. M. M. Kohn, Chicago, Ill. Application filed September 24, 1891.

By means of primary batteries and apparatus for controlling and regulating the current it is proposed to supply light and power for general work.

# Western Electrician.

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## Electrically Operated Factory at South Milwaukee, Wis.

Attention has frequently been directed by this journal to the important field for electricity in the transmission of power in large manufacturing establisbments. The importance of this subject, both to the owners of such factories and to the electrical fraternity, can hardly be over-estimated. To the former it means greater economy, efficiency and convenience of operation and to the latter increased business. The electrical press has done its part in citing and describing plants of this character—now, in this country, numbering several hundred, and almost uniformly successful—and a recent important example was the transmission scheme at the Whitman & Barnes factories in West Pullman, Ill., described and illustrated in the WESTERN ELECTRICIAN of June 23d last. Still the proportion of electrically operated factories to the total number is, of course, small, and each added plant is an advantage as an object lesson to other manufacturers and as affording an opportunity to electricians for the comparison of methods.

Such a plant is that on which the Bucyrus Steam Shovel & Dredge company of South Milwaukee, Wis., depends for its power, and which is illustrated by the accompanying pictures. This installation is noteworthy from the fact that the whole establishment is absolutely dependent upon it for power. There is not a piece of moving machinery in the several buildings, outside of the central power station, that does not get its energy through a copper wire and a motor. Hence the generating plant is in duplicate, a relay machine standing side by side with the working generator for instant use in case of an emergency. In this respect an important difference from the West Pullman plant referred to above will be noted, as only one generator was there provided for a motor equipment larger than the one under consideration. Another distinction is caused by the fact that at South Milwaukee an independent building is provided for the power and heating plant, which was not the case at West Pullman.

The Bucyrus Steam Shovel & Dredge company conducted its business for many years in Ohio, and the present plant, ten miles south of Milwaukee, was established in 1892. There are several buildings, erected according to the modern ideas of factory construction, and 250 hands are employed. The shops are heated by the hot blast ventilating system, the apparatus for which is located in the machine shop, steam being conducted to the air coils from the power house through buried pipes for a distance of 425 feet. Electrical power distribution was an integral part of the scheme for the arrangement of the plant from the start.

The machinery of the power plant is illustrated in Fig. 1. The engine is of 165 horse power and of slow speed, running at 71 revolutions. It is from the Allis shops and of the Corliss type. It is belted directly to a four-pole 150 horse power generator made by the old National Electric Manufacturing company and which has a capacity of 510 amperes at 220 volts. This generator is operated at 338 revolutions per minute. Standing beside it, as shown in the picture, is a second generator, which is an exact duplicate of the first. This is a relay machine, or, to describe the application more exactly, the two generators are run in relay, both being constantly ready for duty, and capable of being used interchangeably. The machines are placed with the pulleys together and about two inches apart. The fly-wheel of the engine is something over twice the width of the belt, so that in case of a burn-out, or when, for any reason, it is desired to transfer the load from one generator to the other, it is an easy matter to shift the belt on the fly-wheel of the engine and to slip it from one dynamo pulley to the other. This change is frequently made in the case of long runs, when the factory force is working overtime, to prevent the possibility of undue heating of the magnet coils, and involves a shut-down of only seven minutes.

The switchboard is a handsome accessory of marbleized slate and is provided with the necessary complement o switches and rheostats, Wirt measuring instruments, lightning arresters and ground detectors. From it the conducting wires are led from the power house to the other buildings in an overhead line, a portion of which is shown in the exterior view given in Fig. 2. The power house also shelters, of course, the steam generating plant, which consists of one 150 horse power boiler. The furnace is fired with soft coal, and the draught is obtained by means of a 95-foot brick stack. Were it not for the economy of the electrical system, dispensing with much power-consuming shafting and using the power only as needed, it would be out of the question to operate a factory of this size on such a small boiler and engine plant. Much more might be accomplished in this direction by making a larger use of individual motors and dispensing with line shafting to a greater degree; and this is an improvement which the future will doubtless witness, when contemplated additions are made to the factory plant.

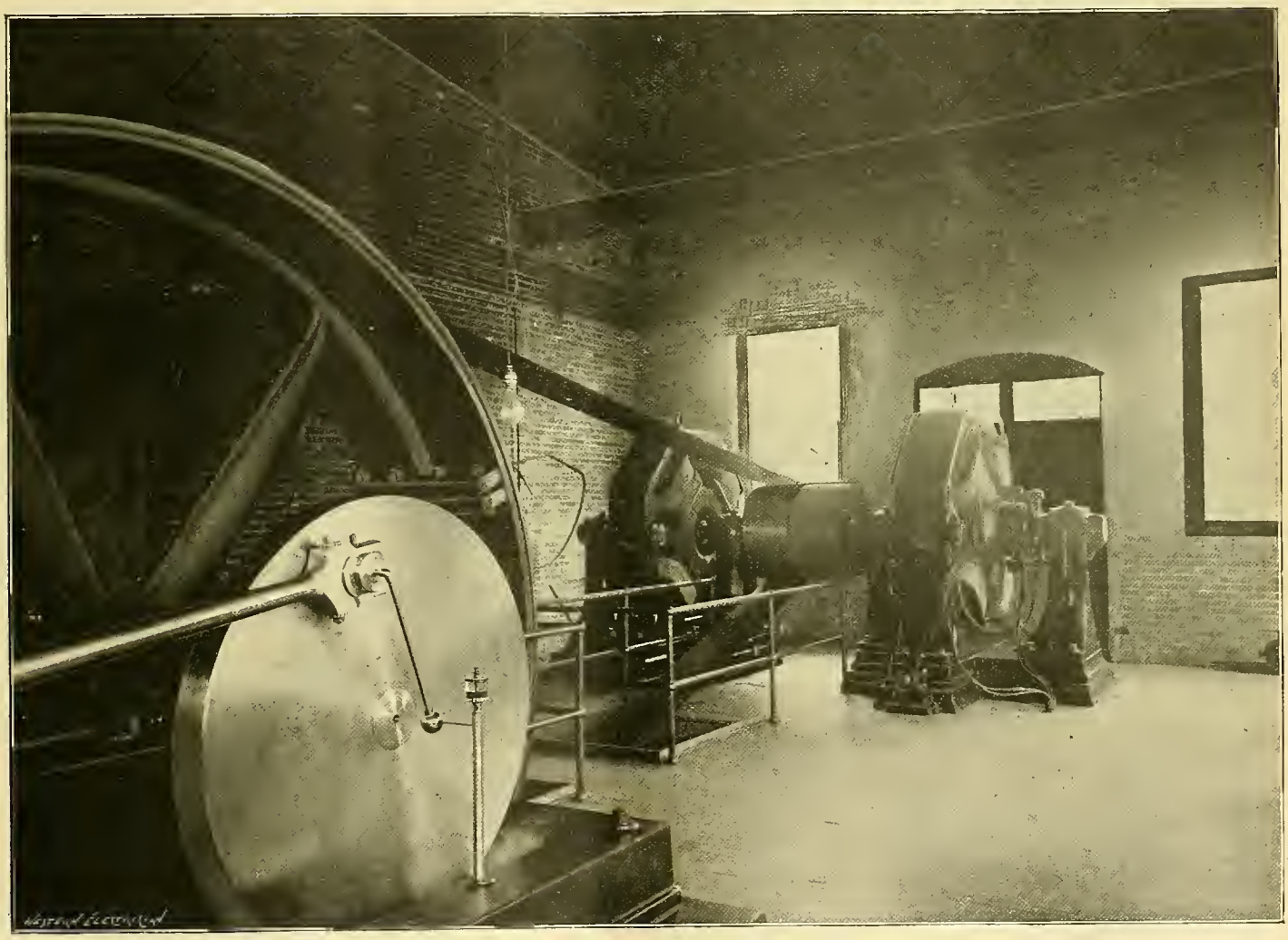

FIG. 1. ELECTRICALLY OPERATED FACTORY AT SOUTH MILWAUKEE.—POWER PLANT.

Mention has already been made of the use of steam for the hotblast heating system. This is accomplished almost entirely by utilizing the exhaust, and only in the severest weather is there any drain on the live steam supply for this purpose. The power house equipment includes also a Worthington pump for fire protection, with a capacity of 1,000 gallons a minute, and a duplex air pump for supplying compressed air for the foundry hoist.

As has been said, all the power for the factory machinery is electrically transmitted. From the power house to the factory buildings there are five power and two lighting circuits of No. 0000 wire. In all, there are 16 motors, ranging from 2 to 16 horse power. Four of these drive line shafts in the largest building—the machine shop—and Fig. 3 shows a Western Electric motor of 16 horse power used for this purpose. At the other end of the shafting to which this motor is belted is a National motor of equal capacity, while two others of smaller size, supported on hanging platforms, drive shorter lines of shafting. By this power metal working machinery of all kinds is operated.

In the pattern shop there are two motors. One of them—a 10 horse power National machine—drives a band-saw, a planer and a rip-saw by means of a jackshaft, as shown in Fig. 4. This motor is covered but not entirely enclosed, and no trouble has been experienced by reason of the inflammable nature of the material surrounding it. A smaller motor in this room, on an overhead platform, supplies current for several other machines.

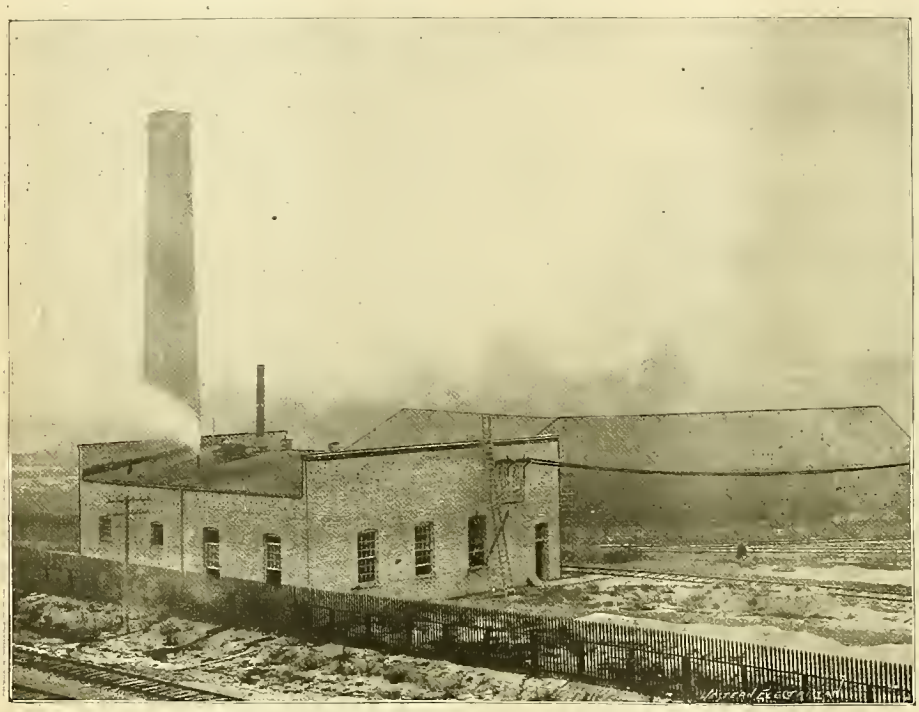

FIG. 2. ELECTRICALLY OPERATED FACTORY AT SOUTH MILWAUKEE.—POWER HOUSE.

An interesting application is that illustrated in Fig. 5, which represents the combined motor and blower in the blacksmith shop. The motor is a 15 horse power machine made by the old National company, and the blower is placed directly on its shaft, as represented in the illustration. Mr. Robinson, the chief engineer of the Bucyrus Steam Shovel & Dredge company, could find no combination of this sort suited to his needs on the market, and so he planned the efficient electric blower that is now in operation. The air is forced by it through a system of pipes to the various forges. A similar equipment is installed in the foundry, where there is also a 5 horse power motor directly belted to a "rattler."

One motor—a 5 horse power National—is located half a mile from the works on the bank of Oak creek. It is belted to a two-inch centrifugal pump, and was formerly employed in maintaining the water supply at the factory, but since the completion of the South Milwaukee water works it has not been used, being maintained as a reserve.

Two ten-ton electric traveling cranes—one in the machine shop and the other in the foundry—transport the heavy castings and parts of machines about the shops. Each is equipped with three Westinghouse motors, for traveling, traversing and hoisting respectively, ranging from 2 to 6 horse power, operated on a 220 volt circuit, as, indeed, are all the motors. These cranes are equipped with platforms for the operators and are directed in the usual manner.

Electric light is, of course, made use of in all the buildings. There are 24 arc and 140 incandescent lights in the establishment. The former are of 1,200 nominal candle power each and are run four in series from the 220 volt circuits.

The electrical equipment has proved entirely satisfactory, and is spoken of in the highest terms by the officers of the company, who have had no reason to regret the choice of electricity as the agent for transmitting the motive power. The chief engineer of the company is A. W. Robinson, and John F. Watt has charge of the power plant.

## Telegraphing Forty-five Years or More Ago.

By C. C. Haskins.

I was reminded the other day, when reading Superintendent Swift's paper on telegraph operators in the olden time as compared with the present race of employes, that possibly some interesting reading for the latter day electricians, with which all the electrical ranks are crowded, might be found in reminiscences of the old telegraph days. There are but few of us left who began with the telegraphic art when Speed and Cornell and O'Reilly, and Vail, Wood, Stager, Partridge, Sam Porter, W. D. Allen, Charley Wells, Henry Faxon, John Burch, Col. Haskins and the writer commenced the art, either as promoters or operators or both, away back in the '40's, before there was a connecting link from the lakes to the ocean.

The express company at the head of which was Henry Wells, which afterward became the American—a little affair with a very limited number of messengers and known as Livingston & Wells—became interested in the scheme of a telegraph line from New York to Buffalo, along the Hudson river and the New York Central roads. When the line had been about completed to Syracuse, the company ran short of funds, and it was decided to ask the western terminal for aid. It was so decidedly new to western capitalists—Buffalo was pretty well west then—that it proved a very uphill sort of work to solicit subscriptions to such a wild venture. "We have no doubt," said they, "that you believe what you tell us, but we will put no money into such a scheme. Why," they argued, "you are going to put your wire on poles, in plain sight of everybody, and the wire will be stolen faster than you can put it up. Every storm will blow it down, and there will be no line half the time. People will not trust their business with you, either. The mail may be a little slower, but it is secret and safe. We want to see this thing before we take any chances on the errors it will make in correspondence. Put up a line and let us see it work."

They did put up a line. A wire was strung from Buffalo to Lockport, with no intermediate office. Registers, with a broad strip of paper—no one read by sound then—were the receiving instruments, and the message came embossed by three points, instead of one. This was a precaution to insure a perfect letter with each impression, and to guard against possible imperfections in the register paper.

This register was an automatic affair. At the front end of the pen lever an arm rested upon the fly-wheel, and held it in position. On the third wheel a series of pins projected, which, when the wheel was in motion, engaged with a hammer that struck a bell. Now, when Lockport wanted to send a message to Buffalo he merely made a few preliminary dots, and sent his "communication," as we called it. The preliminary dots started the machine, the bell rang, and the operator read the message if he was there. A stop was arranged, so the operator could shut off the bell, which otherwise would ring continuously. When the message was completed of course the friction arm rested on the fly wheel and gradually brought it to rest. When the operator came in the message was waiting for him, and he in turn wrote his acknowledgment—perhaps half an hour afterward. That was soon enough then. The operator had to eat, of course, and might be out delivering a message.

The relay was a curiosity also. It was made of four pairs of coils, and the armature, which was horizontal, was a cross in shape, like a sawbuck on end, and was in fact four armatures, one for each coil. It was a rude affair in a candle box and weighed 21 pounds.

There was no calling the office wanted. It was an experimental line with but two offices, and of course if Buffalo wrote Lockport received, and the reverse. Mr. Barnes, I think, was the first Buffalo man, and a very worthy old gentleman named Boughton was the Lockport operator. The Buffalo office was in the express office, and I think the other end was similarly located. When the line was ready for business the newspaper reporters were notified, and complimentary messages by the dozen were sent between friends. All the business men of both places were acquainted.

A few of the more cautious ones devised the cunning scheme of sending a "communication" by telegraph and mailing a duplicate for comparison. While the commonplace compliments might get through all right, it was perhaps a little doubtful if business would go straight.

The telegraph was shown to be a practical thing, and in a short time the line was completed between New York and Buffalo, and an extension commenced reaching over into Canada. The last link finished between Buffalo and Toronto was that between Lockport and Queenston. This was in 1846. The wire over the Niagara was hung in mid-air from the high ground just above Lewiston to the high point above Queenston. There was no bridge between the two countries then. This span was 800 feet of about number 8 B. & S. iron wire, as I remember it.

Of course Lockport had a ground at his end of the line, and when the Canada connection was brought in this ground was left on until Sam Porter and his men could fill in the gap to Queenston. When it was finished I was at the latter place. The connection had been announced by letter to Buffalo, who asked the operator at Lockport to take off his ground "and give us Canada." "All right," said he, and put his ground on the Buffalo side of the instrument. The bell and automatic starter had been done away with by this time and calls substituted. I was watching for him, and feeling the change when he shifted his ground I called Lk. He answered at once, and I sent him a complimentary message, which was probably the first electric message ever sent between two countries. Then St. Catherines, Hamilton and Toronto talked with him and asked the removal of the ground. "All right," said he, and back went the ground while he talked with Buffalo. That blessed ground was kept on, first on the one and then on the other side of his office, until a man was sent from Buffalo to take it off. The operator could not understand how a line could work without a ground at his office.

Operators stood up at their work in those days. Some one had discovered (or claimed to) the fact that to sit down at a table would ruin the operator's health. Then, again, the weight which ran the paper register needed considerable perpendicular space, and the two receptacles for paper boxes, 14 inches square and over three feet high, had to have room somewhere.

Our tables were planks of some hard wood, two inches thick and two feet wide. The wires had no binding screws to hold them on the table, but were bent downward, and the connection was made in a mercury cup bored into the table with a half-inch auger. It required a mechanic to set the instruments. The key was in two pieces; the connections made underneath the plank. The anvil of the key had to be set with too much precision to allow a boy to attempt it, and a necessary adjunct to the key, which everyone made for himself, was a keeper to close the circuit between the anvil and the key. This was a V-shaped wire affair, with the ends turned up into fancy "curlycues," according to the whim of the constructor.

Our batteries were of the Grove variety. Zinc cylinders with platinum foil soldered on a horizontal arm were the metals. A large tumbler of dilute sulphuric acid received the zinc, which in turn held a porous cell of nitric acid, into which the platinum of the next cell was immersed. The rapid deterioration of nitric acid when exposed to the air rendered it necessary to economize, inasmuch as no business was transacted after 8 or 9 o'clock P. M., and the batteries, both main and local, were taken down every evening. The

operator was also battery man. The porous cells were all emptied into either a large bottle or a carboy, according to the size of the battery, and corked up to exclude the air till morning. At six the next morning one-half new and one-half old nitric was mixed to fill the porous cells to be ready for business at 7 o'clock roll-call. When the battery was taken down at night the zincs were all washed, brushed with mercury to amalgamate them, "boiled" in sulphuric acid and water if they were black, to clean them, and left in water over night. If any of them had a broken platinum, the operator was a tinsmith and soldered it or another one on. A plan was adopted to save the waste of battery material, by which the line when idle would not be eating up the zincs, and destroying the acid. We called it keeping circuit. The operator receiving the message said O. K., and the circuit was then his to hold—by occasional closing- until some one else wanted it. Now to sit and close and open a key for 15 or 20 minutes, once in a second or so, is no pleasant labor. One of the operators on the line exercised his ingenuity to the extent of making his clock pendulum do the circuit keeping for him while he read law. When the register ceased to respond he closed his key with his wedge, and went on with his reading. It worked well until one day when his clock was keeping the circuit a fire broke out in the neighborhood, and he went to see it. The clock did not know enough to close the key when some one else opened, and when the inventor returned he found several operators who had been trying in vain to silence the clock. It went out of service that day.

When the line broke the operator became linesman. He was not always supplied with climbers. A so-called light ladder was plenty heavy enough for the boys who held small offices. If the line was along a railroad the ladder was taken on a hand-car, and if possible two of the operators manipulated it. If they were fortunate they might have a three-wheeled car, which was not extremely hard to run, except in cases where a mischievous engineer chased them, keeping his train just far enough away to be safe, but pressing them all he dared, not allowing them time to get the car off the track until a switch was reached.

If the office had but one operator, it was usual when he went after a break to post a notice on his door, "Gone out to mend line; be back to-morrow."

The operators in small offices had plenty of spare time on their hands, and it was often difficult to dispose of it. Nearly always some young acquaintance would be taught to write and read, and the principal could get a day off in return, when a picnic or a party of sportsmen needed his services or presence. Games of checkers and chess were played between operators by telegraph, conundrums were asked, and extracts from books were repeated by telegraph. Gen. Myer, who was the original "Old Probabilities," was an operator with whom I have exchanged whole pages in that way. When nothing else offered "drumming" was resorted to. An operator would call some office, and say, "Guess what tune this is?" and drum the time of some air. Some operators became very expert at this, and as it was really good practice in the making of dots it was not objected to by the superintendents, who were also operators when necessary. As lines multiplied it was thought there should be a code of abbreviations. Operators were required to commit these to memory before they were deemed qualified for an office. These were mostly used for press reports, for the greater part of all the lines had but one wire, and the daily press reports occupied much of the time. Hours became longer, offices remained open nearly, some quite, all night, until the demands of the public rendered it necessary to quite thoroughly change the old styles for something better.

During the days when we closed the offices from 6 P. M. until 7 A. M., I have more than once been called out of bed at night to know if I wouldn't go to the office and send a message. As the battery was soaking in the water tub at that time of night, of course I didn't grant the request. Among others who made this midnight raid upon my boyhood's rest was Charles Dickens, the author, but I didn't find it out until the old Scotchman with whom I boarded told me the next morning.

The abbreviations of which I spoke were largely phonetic, but many were arbitrary, and the list was not by any means easy of accomplishment, because of these elements. A few of these are still in use, mostly figures, which stand for sentences: 1, meaning "Wait a moment," is I think universal; 30, for end of report, and 73 are both common. But few of the present old timers would be able to translate a sentence like the following, I fancy:

"A e o tirs f forty years ago w tk ts easy perhaps. Ut ty w h to k sm ti to rk it out v ty r ms ikly to be smwt rusty i ts ti."[1]

Mistakes very naturally occurred, and no little trouble arose out of the use of these abbreviations, and they were soon tabooed, except in reports. Reports were read from the tape, and the newspaper representative copied as they were read. Now and again the copyist would get behind and a peck or so of paper would pile up on the desk. In the meantime perhaps something would throw the relay adjustment out, and the sender would have to repeat a quarter of a column perhaps after all had finished copying save that one. Reading by sound was the exception. A few were capable, but there was an order that all messages must be received on and read from paper.

I was once taking the afternoon report at Lockport, whither I had gone to relieve the operator, who was not a sound reader. In the midst of the report there was a commotion in the street, and I ran to the window to see the cause, but kept on reading. The copyist got "huffy" because he thought me fooling him, but finally took the rest of the report. When the report was finished I turned back and read from the tape a sufficient amount to convince him. This new method of telegraphing made him a splendid item, and the notice "our young and gentlemanly operator, Mr. Haskins," received the next day was a stunner, while I was on exhibition for several days afterward—a telegraph freak.

The strife between the two factions, which were represented on the one side by the Speed family and on the other by the O'Reilly interests, grew into an almost open war. The struggle to outdo each other was almost consanguinous. The operators in many instances quarreled openly, the linemen collided, and the courts were busy with all sorts of charges and countercharges. The smallest town which lay along the parallel routes of the west-bound lines had one of each following. The signs of the offices were somewhat peculiar. One I remember over a prominent office read: "Electro-magnetic Telegraphery Dispatches Communicated." The envelopes always bore the legend: "All communications strictly confidential;" but in addition to this an occasional local solon would add some written wisdom. The envelopes in a western town were endorsed with the following gem:

I fly with the lightnings of heaven,
I travel unseen and unread;
A thought and the impulse is given,
A touch and the message is sped.

The hand of Jove grasping a package of thunderbolts was common, and the envelopes of the district from Buffalo to Chicago by the O'Reilly lines told that they were issued by the "Atlantic, Lake & Mississipi River Telegraph company—Lake Erie Division."

The enmity between competing offices in small towns was bitter indeed and the means adopted for securing customers from each other were not always either honest or honorable. An illustration which I know to be in every particular as stated will suffice.

In a town where the total receipts were not over five dollars per day, a boy had a monopoly of the business until the opposition established an office. The boy was an importation, the new man a native of the place, who as soon as his office was opened went deliberately to work to malign and backbite the lad to his customers. In a couple of weeks the youth had lost nearly all the business and his competitor openly boasted of his success. The boy procured entrance to the man's office, went into it on Saturday night, and by the light of the moon concealed a wire leading from each side of the window, where the line entered, to two pieces of zinc beneath the stove, the legs of which rested on wooden blocks. The office was never half swept and the broom assisted in covering the wires in the floor cracks. Three times out of four for the whole of the next week, when the tongs were thrown down on the zinc they made contact which cut out the office, and the irregularity with which the instruments worked brought back all the boy's patrons and many more. The burglar's key was once more used to cut off the wires, and neither the man nor the company ever knew 18 (what's the matter?)

[1] All of the old timers of forty years ago will think this easy perhaps. But they will have to take some time to work it out, for they are most likely to be somewhat rusty by this time.

## Some Advantages of Alternate Currents.[1]

By Prof. Silvanus P. Thompson.

Among electrical engineers there remain a few, chiefly of the old pioneers, who have not yet grasped the advantages possessed by alternate currents over continuous currents in systems of electric supply. Superstitions still linger that alternate currents are less easy to manage, or are less economical, or are more dangerous, or are less readily measured than continuous currents. There is a special superstition that they cannot drive motors. Such superstitions once set afloat die hard, and sad to relate they are sedulously fostered by a few interested persons who ought to know better. The present paper is intended to point out a few of the more salient advantages attendant on their use, and to add a few points that have recently claimed the writer's consideration, and are not yet generally known.

FIG. 3. ELECTRICALLY OPERATED FACTORY AT SOUTH MILWAUKEE.—MOTOR DRIVING LINE SHAFT.

It is well known that the economic transmission to a distance of electric energy depends for its success on the use of high voltages or pressures. The reason is that power depends on the product of two factors—current and pressure—and that of these two factors the former, current, involves some waste in the conductors. If large currents are transmitted at low pressures, there will be either much power wasted as useless heat in the copper conductors, or else the conductors must have such large cross-section that the interest on their prime cost involves a still more serious waste. If small currents are used at high pressures—1,000 volts, 5,000 volts, 10,000 volts, as the case may be—the copper conductors may be small and the interest on their cost a trifling quantity.

Now this all-important fact to the electrical engineer is absolutely independent of the nature of the current, as to whether it is continuous or alternating. The advantage of alternating over continuous currents comes in in the circumstance that high pressure cannot be used in houses without being transformed down to low pressure. Hence the system which admits of transformation by a stationary transformer, consisting merely of two coils wound upon a common core, is to be preferred over one that requires running machinery for transformation.

[1] Read before the British Association, August 13, 1894.

Again, it is an advantage not only for high voltage systems, as distinguished from low, but in all systems, whether high or low, in which currents of considerable magnitude have to be collected and delivered, that there should be no necessity for employing either in the generating plant or in motors any commutators or sliding contacts with their adjustable brushes and the like paraphernalia. The commutator, the indispensable adjunct of the continuous current dynamo and motor, has long been known to be its weakest part, from the engineering point of view. It is complex and costly as compared with other parts. It requires far more attention than any other part of the machine. It undergoes greater wear, and the circumstance that under conditions not far removed from normal it may give rise to serious sparking is also a disadvantage.

Alternate current generators have no commutators. Those types of alternators in which the armature revolves require, indeed, collecting rings (for sliding contacts) and brushes, a device to which the foregoing remarks on commutators scarcely apply, seeing they need no adjustment nor give rise to sparks. But the types of alternator now coming in favor do not even require these (except on the exciting circuits, where their disadvantages are *nil*), since in them the high voltage armature parts are stationary. The only part that need revolve are most substantial masses of iron and copper needing no special insulation in their construction or attention in their operation. To be spared all the troubles arising from commutators and brushes is no small advantage in itself to the central station engineer.

Another advantage of an entirely different character is the greater safety of alternate currents. With them there is far less likelihood of trouble from leaks in the distributing circuit than if continuous currents were used at the same voltage. This arises from the circumstance that the electrolytic action of the alternate current is so extremely small. If there is a weak point in the insulation of a main or branch conductor where damp can get in to form a path for leakage, the continuous current will find it out and promptly set up chemical corrosion. Corrosion sooner or later ends in setting up an arc and an outbreak of fire results. The corrosions of water and gas pipes complained of in many districts where a continuous current supply is maintained are unknown where alternate currents are used. The danger to life for equal voltages is, I think, now established to be greater with continuous currents than with alternating, as their destructive action on the tissues is greater.

Again, it is no light matter that while in a continuous current supply there is but one way of moderating or regulating the strength of the current which flows to a lamp or motor from the supply mains at a given pressure, there are two modes of regulation possible if the supply be one with alternating currents. In the continuous current case we regulate by introducing resistances, which regulate by wasting power. It is as though when we wanted to put a slow speed onto a power lathe we did it not by changing the gearing, but by putting a grindstone on the same piece of shafting and slowed it down by grinding something that would waste the power. But in the case of alternate currents, though we may still, if we please, regulate by wasteful means, we have another and non-wasteful way available in regulation—viz., the use of so-called choking coils, or reactance coils, which operateby setting up opposing electromotive forces in a purely automatic way—damming back the currents instead of wasting them. The use of choking coils is destined to find a very great increase in services of this kind.

It would be traveling too far from the range of this paper to enter to any great length upon the work that has been done during the past five or six years with combinations of two, three or more alternate currents of different phases. Two-phase and three-phase combinations of alternate currents, using three or four wires for their transmission instead of the ordinary two-wire system of conductors are now quite well known and their advantages in special cases are fully recognized. Of course it will be at once replied that any phase system of currents that is a combinations of two or three alternate currents, and requires three or four wires instead of two, cannot be entirely an advantageous system as compared with simple continuous currents, being more complicated. This is very obvious, and yet the fact remains that with two-phase and three-phase systems of currents one can accomplish results which the simpler systems cannot accomplish, and meet conditions which the simpler systems cannot meet. Without attempting any complete exposition of the phasal systems, let one or two points suffice for remark. It has been found essential, or at least advantageous, in those districts where continuous currents are used on a large scale, to depart from the sweet simplicity of the two-wire system, and in order to economize in the total cost of copper in the mains to adopt a three-wire or a four-wire or even a five-wire distribution, so that sweet simplicity is not always on the side of continuous currents. Again, if a three-wire three-phase system of alternate currents is used, the total weight of copper needed in the conductors (at equal voltage) is less than in the ordinary two-wire system for an equal amount of power, whether that two-wire system be with continuous currents or with alternate currents. The main advantage of three-wire polyphase alternate current systems (whether three-phase or two-phase) is, however, the greater facility that they offer in the handling of motors, since they are more readily made self-starting than is the case when merely single alternating currents are supplied on a two-wire system of distribution.

At the Electrical Congress of Chicago, in the debate on a paper by Mr. Scott of the Westinghouse company upon polyphase systems, the writer expressed the opinion that while a polyphase system was adapted to the case of the transmission of power from a single generator to a single motor, in the generality of cases in which the power was to be not only transmitted, but distributed to a number of motors at independent points, the greater simplicity of the simple alternating current would render it preferable now that self-starting motors were in the market. Bearing, however, in mind the advantages to be derived in the possibility of using two and three-phase motors, the author gave considerable thought during the winter to the problems of transformation, and particularly to the question whether it might not be possible to transform alternating currents from two-phase to three-phase, or from either of these to single-phase, or *vice versa*. No mode of doing this was known save by the combination of motor generators as running machines. As one result of his cogitations, he found that such transformations might be readily effected by stationary transformers, or in the least easy case by stationary transformers with a revolving iron core. The simplest case—that of transforming three-phase currents into two-phase (or *vice versa*)—involved no moving parts, being effected by using a ring coil (or its magnetic equivalent) with connections made appropriately. For example: If a gramme ring is connected, as shown in Fig. 1, to a two-phase system with 100 volts between *A A*, and 100 volts in quadration between *B B*, a three-phase set of alternate currents may be taken off from the same winding at three equidistant points, *P, Q, R*, at pressure of 66 volts between each of the three wires. The magnetic field across the coil revolves, and it is preferable to provide a laminated core to complete the magnetic circuit. Such a core may be stationary, or may revolve. A simple ring transformer like the above (without revolving core) was shown by the author at his lecture on the transformations of electric currents at the Royal Institution on February 23, 1894. It is of some interest to note that on March 7th Mr. Scott read an elaborate paper to the American Institute of Electrical Engineers, in which he gave an independent solution to the very same problem, using two sets of windings (instead of one) but working out in detail many possible applications. It is no exaggeration to say that an electrical engineer starting, let us say, with three-phase alternate currents as the method of supply, is in a position to furnish any customer who may desire either two-phase currents or single-phase currents with what he desires by merely putting in a small appropriately connected transformer. Another advantage, about which even electrical engineers are as yet almost wholly unenlightened, arises in the application of alternate currents to electro-magnets. Great as have been the services of electro-magnets as used with continuous currents, since their invention in 1825, they are destined to fulfill wider services than ever, in practical problems of an electro-mechanical nature now that their properties, when supplied with alternate currents, are becoming known. In 1887 Prof. Elihu Thomson discovered a number of singular properties of alternate current magnets in producing repulsion of copper disks and rotation of cylinders and balls by reason of the eddy currents induced in them. During the past winter the author has been studying the design, construction and properties of alternate current magnets, and recently, in conjunction with his assistant, Miles Walker, read a paper on the subject before the Physical Society of London. A few words on this topic will emphasize the advantages offered by alternate currents in this application. It has long been known that the magnetic forces of a magnet fall off very rapidly at small distances from their poles. For steel magnets in those cases in which the poles can be considered as points, the force falls off inversely as the square of the distance, other things being equal. In the case of soft iron electro-magnets operated by continuous currents, the pull on their armatures falls off much more rapidly than this. The forces when in contact may be relatively enormous and yet the magnet may have no range of attraction worthy of mention. A pull of 150 pounds in contact may dwindle to a few ounces at a distance of a couple of inches.

But with alternate currents supplied at constant voltage from the mains, the author finds all this to be different; with a properly designed and well constructed electro-magnet, the pull on its armature can be kept fairly constant over a considerable range. Nay, in some cases can be caused to be greater at a distance than when near. For example, the author has lately had an alternate current magnet constructed for him by Mr. Walker, the pull of which, when excited at 50 volts, was 8 ounces when the armature was closely in contact with the core, but which exercised a pull of 32 ounces when the space between them was 3 inches. This obviously introduces into electric mechanism a new element hitherto undreamed of.

The secret of these things is that in the case of alternate current electro-magnets, the self-inductive reaction of the system, and not the mere electric resistance of the wires, is that which governs the flow of current, whereas Ohm's well known law for continuous current is

$$\text{Current} = \frac{\text{Electromotive force}}{\text{Resistance}}, \text{ or } C = \frac{E}{R}.$$

The rule that governs the alternate current in these cases is different, being

$$\text{Current} = \frac{\text{Electromotive force}}{\text{Reactance}}, \text{ or } C = \frac{E}{p\ L},$$

where p is the pulsation of the alternate current, that is, the number of radians per second in the revolution of the circle of reference, and L the inductance.

As the armature of the alternate current magnet is withdrawn from the core, the reactance diminishes and more current flows, making the pull greater at a distance instead of less.

Another curious point about alternate current magnets relates to their winding. In the case of electro-magnets supplied with continuous currents, it is well known that the more turns of wire that are wound on the core, the more powerfully is it magnetized. But with alternate current magnets this is not so. There is one particular number of windings for each magnet (generally a small number) for which the magnetism is a maximum, and any additional wire wound on above this number diminishes instead of increasing magnetic power.

Returning from this digression respecting magnets to the general question of the supply of alternate currents, the author has finally to point out one further set of advantages hitherto both neglected and unknown in this country, though known to a few and actually in use in the United States.

One of the difficulties which beset the distribution of electric currents on the large scale is that of maintaining constant at all points of the network of conductors the voltage or pressure at which the current is delivered to the consumers. Between the generating station and the center of distribution there occurs a loss of pressure (comparable to the loss of head in the case of water power,) and beyond the center of distribution between it and the points of consumption in the house lamps there is a further drop in the voltage. The former drop in the voltage can be compensated for by due arrangements at the central station, but the further drop between the distributing center and the consumers' houses, though it may be guessed at and partially compensated by some means of over-compensating at the distributing center, cannot be accurately compensated. The result is that the consumers' lamps do not receive their supplies of current at an unvarying pressure. Now in the case of continuous current distribution, the only cause for drop in the voltage at distant points is the resistance offered by the conducting wires leading to those points. The drop due to such resistance—or ohmic drop—is proportional to the ohms of resistance and to the amperes of current. Suppose a group of lamps requiring 20 amperes at some outlying point, the wires to which have a total resistance of only one-tenth of 1 ohm. The drop in voltage, due to the ohmic resistance, will be $20 \times 1 \cdot 10 = 2$ volts. The lamps, which ought to receive their currents at a pressure of 100 volts, only receive it at 98, and burn dimly in consequence. But in the case of alternating currents there is a second or additional cause of drop, which has hitherto been held to be a serious disadvantage in their use, namely, a drop due to the self-inductive action of the lines, reacting and setting up back electromotive force, and tending to choke the current. In general, this second or inductive drop is not serious, the mains and branches being arranged concentrically for the purpose of avoiding it as far as pos-

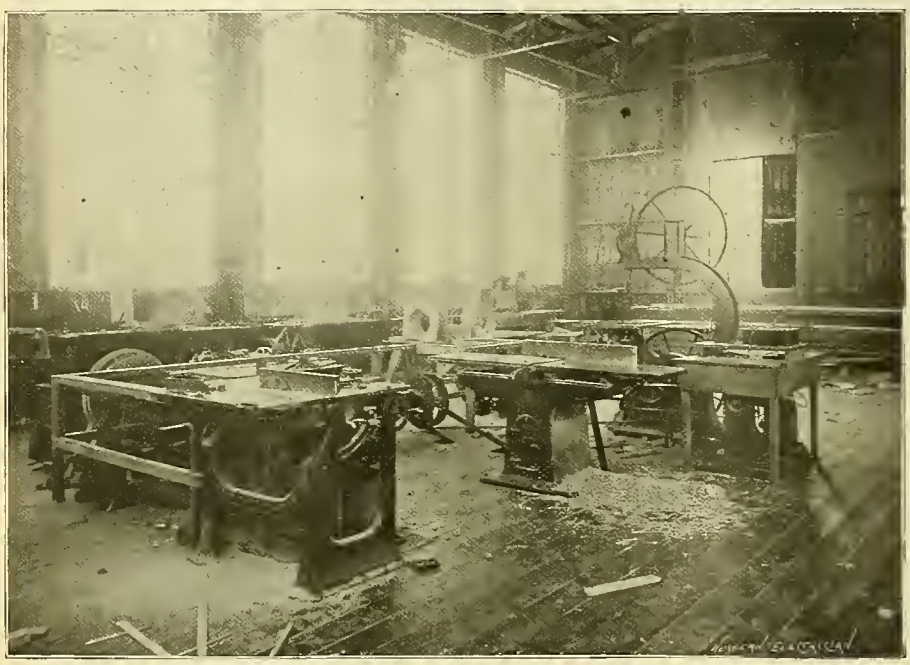

FIG. 4. ELECTRICALLY OPERATED FACTORY AT SOUTH MILWAUKEE.—PATTERN SHOP EQUIPMENT.

sible; but it may become serious when motors as well as lamps are employed upon the circuit, because of the considerable inductive reactions that are set up in the electromagnetic operations of these machines.

Alternate current motors are of many sorts, but may be grouped under two chief classes, the synchronous and asynchronous. Synchronous motors are those which only run at one fixed speed determined for them, irrespective of their load—a speed determined solely by the number of their own poles, and the number of the alternations imposed upon the current by the generating machinery at the station. They must either run in synchronism with the pulsations of the current, or not run at all. The other class, the asynchronous, are mostly polyphase machines, requiring two-phase or three-phase currents to operate them. The phase currents, led into a suitable armature, there combine to produce a rotating magnetic field, and in this rotating field masses of iron, or iron carrying closed circuits of copper, are set into rotation, being magnetized inductively, and dragged round by the reaction of the eddy currents induced in them. The rotor or rotating part of the asynchronous motor may be regarded as a revolving field magnet, not magnetized by any special exciter or initially, but magnetized only by the eddy currents induced in it. Now if it could spin at the same rate as the revolving magnetic field that surrounds it, there would be no relative motion, no eddy currents, no reactions, and no driving force. It is driven by forces which depend for their existence upon the rotation not being synchronous with the pulsations of the currents in the circuits. Within certain limits it adjusts its speed so that its magnetic slip is proportional to the turning moment which it is called upon to exert.

Now, owing to these necessary reactions, the asynchronous motors produce upon the mains which supply them an inductive drop, and cause the pulsations of current to lag in phase behind the impressed pulsations of voltage. Whereas the ohmic drop is not accompanied by any lag of phase in the current, the inductive drop is so accompanied. Happily, with alternate currents, there exists more than one remedy. It has long been known that a condenser exercises a reaction of another kind, which, though it tends to choke the currents, does so not by retarding the phase of the pulsation, but by accelerating it. This precious property has long been known and used in submarine telegraphy to compensate, by the use of condensers, the retardations of the signals. But to apply condensers to systems of alternate current supply for the purpose of counteracting the inductive drop when motors are used would be a rather formidable task; the remedy is too heroic for the malady.

A remedy of a different kind is, however, possible, and must before long become general when its advantages are known. To explain it we must return to the subject of synchronous motors, about which little has been said. It was shown in 1868 by Wilde, and in 1879 by Hopkinson, that two alternate current machines could run together synchronously, one as generator, the other as motor, the one which served as motor adjusting itself so that its pulsation of electromotive force tended (as in all motors) to oppose those of the impressed electromotive force. In 1884 Dr. Hopkinson further predicted that an alternate current machine could run as a motor, even if its mean electromotive force was higher than that of the circuit, a result verified in practice by Mr. Mordey in 1890. In 1892 Mr. Mordey gave at the Institution of Electrical Engineers some further results of alternate current working, including a very remarkable curve, here reproduced, showing the dependence of the armature current upon the excitation of the field magnets of the motor when loaded with a given load. To this curve and its meaning the author directed attention

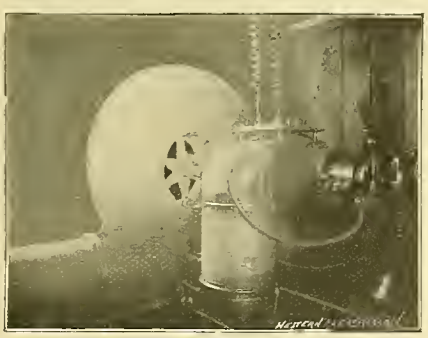

FIG. 5. ELECTRICALLY OPERATED FACTORY AT SOUTH MILWAUKEE.—DIRECTLY CONNECTED MOTOR AND BLOWER.

at the time, and he has since given much thought to it. It will be found to be most significant. The curve presents the form of a letter V. The lowest point corresponds to a particular state of things, namely, that the motor, having its magnetism excited to a particular degree, draws a certain minimum amount of current from the mains, in order to drive its mechanical load at the speed imposed upon it. But to do the same work, drive the same load at the same speed, will take more current from the mains if the excitation of the magnets is either more or less than this particular amount. This seems very strange, but the explanation and its consequences are no less so. The particular stage of excitation which makes the armature current a minimum for the particular load in question is that stage which corresponds to there being no difference of phase between the pulsation of impressed voltage and those of the resulting current. Suppose, for example, the armature had a resistance of ½ ohm, and that the current was supplied at 100 volts, and that a current of 10 amperes was found the minimum current that would drive the load. It would be found (approximately) that the excitation corresponding to this minimum current would be such as would make the motor work with a back electromotive force of 95 volts, for then by Ohm's law $(100-95)\div\frac{1}{2}=10$ amperes. But now suppose the excitation is lessened, the machine acting at the same unalterable speed will generate less than 95 volts. Suppose it drops to 90 volts. Then, if nothing else happened, the current would increase to $(100-90)\div\frac{1}{2}=40$ amperes. But 40 amperes at 90 volts is much more power than 20 amperes at 95 volts, and is more than is wanted for the load. What must happen? The machine is synchronous and cannot—physically cannot—run faster so as to take up this power. It tries to do so, with the result that it shifts the phase of its reactions, the current now lagging in phase behind the impressed electromotive force—choked down, in fact, from the 40 amperes to something more than 20—choked down, in fact, to such an amount as would, if multiplied by the cosine of the angle of lag and by the 90 volts come up to the same product as the original volts and amperes, viz., $95\times10=950$. The synchronous motor, if under excited, acts, then, as a choking coil, producing a reactive drop. But continue the argument the other way. Suppose the excitation is increased so that the 95 volts become 100 volts $(100-100)\div\frac{1}{2}=0$, and there would be no current at all to drive did not an adjustment of phases come into play. Instead of the current dropping to zero, more current than before now comes into play, and that current has its pulsations in advance of those of the impressed voltage, there being now an angle of lead in the phase relations. In other words, the synchronous alternating motor if over excited acts as a con-

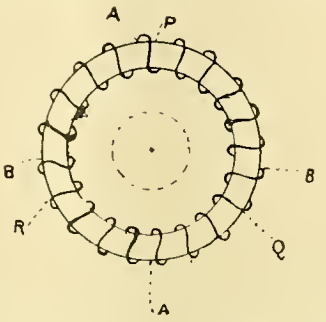


FIG. 1. SOME ADVANTAGES OF ALTERNATE CURRENTS.

denser, and instead of producing a drop in the voltage tends to raise it by compensating the inductive drops, due to self-induction in other parts of the circuit. When the importance of this deduction from Mr. Mordey's curve dawned upon the author, he began to prepare to test it upon the mains of the City of London Electric Lighting company. But before experiments could be even arranged, he learned that the same conclusions had been arrived at by the officials of the General Electric company at Lynn, Massachusetts, and that they had found it in practice to work out favorably. By the courtesy of W. F. Parshall, one of the engineers of that company, who had long been associated with Prof. Elihu Thomson, Mr. Steinmetz and other engineers, the author is able to state the following particulars. They found that in a line where self-induction played the part of a choking coil it did not matter very much whether the voltage needed for driving the current through the line and machine was situated mainly in the generator or in the motor, as the mean voltage in the line was not far from a mean between that of the two. Accordingly, in a three-phase power transmission at Hartford, Conn., of 300 kilowatts output, the motor was arranged to be over-excited. Later, after Mr. Steinmetz had submitted the question to calculations, this feature was introduced into the synchronous motors used in all their recent power transmissions, so that by proportioning the armature reaction and the over-excitation to the self-induction likely to arise, the voltages on the circuit remain quite constant regardless of load within the limits of the capacity of the machines. In thanking Mr. Parshall for his information, I may add two points of comment. The advantage so to be derived from over-excitation have indirectly another advantage, viz., that for single transmission cases the motor and the generator may be designed and constructed as identical machines, instead of the motor being made smaller than the generator. Further, the regulation of the voltages in such a network as that of the City of London Electric Lighting company, instead of being made more difficult when motors are much used—as was feared by some engineers—will be more easy, provided the motors are of the over-excited synchronous type. For the acceleration of phase these produce in the current not only tends to compensate for the inductive drop in the mains and transformers, but tends to reach right back through the system to the generators in the central station, acting on them as a compound winding would, and assisting them not only to counteract the inductive drop, but also the ohmic drop, both between the consumers' lamps and the distributing points, and also between these points and the generating station.

So manifest is this advantage that it would seem worth while to erect at one or possibly more points of the network, as remote as possible from the generating station, synchronous motors over-excited, to act as condensers in compensating the inductive drop, or in the primary circuit also to furnish the idle currents for magnetizing the transformer primaries.

With such possibilities open in the future for alternate current working, and with such advantages in respect of motive power over continuous current working, it can hardly be doubted that, save in a few special cases, the vast majority of central stations will henceforth be operated by alternate currents.

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A recent fire in the Westinghouse company's laboratory at Pittsburg did damage estimated at from $5,000 to $10,000.

Electric elevators are proposed for the city hall building in Rochester, N. Y. C. R. Barnes, city electrician, can give information on the subject.

## Canadian Electrical Association.

The annual meeting of the Canadian Electrical association will be held at Montreal on Wednesday, Thursday and Friday, September 19th, 20th and 21st. The sessions will be held at the Mechanics' Institute Building, 204 St. James street. Queen's Hotel, near Bonaventure depot on Windsor street, will be the headquarters of visiting delegates, a special rate having been secured for accommodations.

The first meeting will be held on Wednesday at 11 A. M., when the usual routine business will be transacted, including the reading of committee reports and the statement of the secretary and treasurer. Several papers will be read at this meeting. The committee on entertainment has arranged a trip to Lachine for Wednesday afternoon, returning by way of the Lachine Rapids. On Thursday morning at 9:30 o'clock the members will visit McGill University by invitation of the faculty of applied science and Prof. Charles A. Carus-Wilson of the electrical department. The visitors will be given an opportunity to inspect the electrical laboratories and witness a practical test on a transformer of apparatus for the measurement of alternating current. The regular session of the convention will meet at Mechanics' Institute at 11 A. M. In the afternoon at 4:30 o'clock there will be a special excursion on the Montreal Park and Island electric railway to Back River. Dinner will be served at Pelequin's Hotel, Back River, at 6 P. M. It is expected that the regular business of the convention will be finished on Friday morning, when the election of officers for the ensuing year will take place. The afternoon will be devoted to sight-seeing. By courtesy of the Eugene F. Phillips Electrical Works, the visitors will be driven to Mount Royal Park, and they will also be afforded an opportunity to inspect the Montreal street railway power house. In addition to these pleasant features the committee announces that Ahearn & Soper of Ottawa have extended the visitors an invitation to visit Ottawa and examine the points of interest and the electrical features of the town. The list of papers to be presented at the convention covers a wide range of subjects, and will attract the attention of members in every department. Following is the order in which the papers will be read:

WEDNESDAY, 11 A. M.

Paper on "The Application of Electricity for Medical and Kindred Purposes, from Light and Power Circuits," by W. B. Shaw, Montreal.

Paper on "Electrolysis," by J. A. Baylis, Bell Telephone company, Toronto.

Paper on "Alternating Motors," by L. M. Pinolet, Montreal.

THURSDAY, 11 A. M.

Paper on "Electric Brakes," by Elmer A. Sperry, Cleveland, Ohio.

Paper on "A Method of Distribution with Equalization

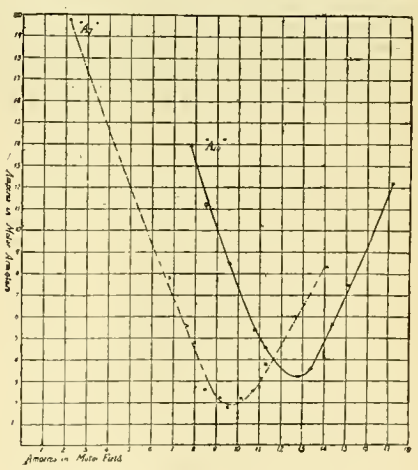

FIG. 2. SOME ADVANTAGES OF ALTERNATE CURRENTS.

of Potential Difference," by D. H. Keeley of the government telegraph service, Ottawa.

Paper on "The Possibility of Securing Better Regulation at Central Light and Power Stations by Means of Flywheel Accumulators of Improved Construction," by John Galt, C. E. and M. E., Toronto.

Paper by John Langton, Toronto.

FRIDAY, 10 A. M.

Paper on "Municipal Electric Lighting," by E. Carl Breithaupt, Berlin, Ont.

Paper on "Telephone Cables, their Construction and Maintenance," by F. J. Schwartz, Bell Telephone company, Montreal.

Paper by T. R. Rosebrugh, lecturer in electricity, School of Practical Science, Toronto.

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The Larchmont Electric company of Mamaroneck, N. Y., has placed the contract for its new station with the Berlin Iron Bridge company of East Berlin, Conn. The building will be 50 feet wide and 90 feet long.

Western Electrician

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**CORRESPONDENCE** relating to electricity or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK
CIRCULATION, 16,630.

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AN English contemporary prints the following interesting item, which will serve to illustrate the enterprise of our friends on the other side, and their methods of handling "news:"

CABLE INTERRUPTIONS.—No interruptions are recorded this week.

ANNOUNCEMENT is made in the press dispatches that the waters of the "accidentally" formed reservoir in the Himalayas known as the Gohna Lake have now reached within 50 feet or so of the top of the natural dam. The length of the lake is now 4½ miles, its average width one-half mile, and its average depth about 500 feet, which is also, it is said, about the height of the dam, which is almost vertical. It has been suggested that the water thus stored be utilized in generating power to be electrically transmitted, but for what purpose or to what point has not yet been divulged.

THE prospect of the equipment of the Lake street "L" road in Chicago for operation by electrical power is but another indication of the gratifying progress made in convincing managers of elevated railways that electricity affords them a better and more economical method of propelling their cars than steam. Recent events foreshadow the day when all of the elevated railway lines in Chicago will be operated by power electrically transmitted from central stations, and if the change is demonstrated to be advantageous to both the public and the companies, as will surely be the case, a like transformation will be witnessed in New York. Elevated electric railway projects are also under consideration in Philadelphia and other cities, and the era of development in this line, which was noted when the Metropolitan company of Chicago awarded its contract, seems to be now fairly entered upon.

UNLESS all signs fail Philadelphia will be the scene of a lively fight when the city contract for street lighting is awarded. It is said that the Philadelphia Traction company has made arrangements to light the streets through which it operates its trolley lines. The first announcement of this project was denied, but there seems to be good reason now to believe that it is the intention of the railway company to enter the lighting field. It may find this a hard task, however, as many grave questions will confront it. It is contended that under its charter the Traction company has no right to engage in public lighting. This is but one of many serious objections that the company will have to face.

MILWAUKEE aldermen were clamoring for revenge, and the street railway company was denounced by every ward heeler in the Cream City a couple of weeks ago. At that time a movement was instituted looking to the acquirement of the lighting and street railway plants now operated by private capital. But when the aldermen looked into the matter more closely, even their stupidity was not so great that they did not realize the folly of their plan. But these misguided officials continue to stir up strife and keep the people discontented. Of course, by continning this policy, they can cause the company much annoyance, but they can do themselves no good, and the injury inflicted upon the company will eventually be borne by the city.

CHICAGO will soon become as noted for surface electric railways as it was two or three ago for its aversion to the much-abused trolley. Each of the three great street railway sytsems—North, West and South Side—is taking active steps to replace animal by electric power on nearly all except the main cable lines, and horse cars will soon dwindle in number to an insignificant minority. The transformation is a remarkable one, when the bitter opposition that greeted the first proposal to introduce the overhead trolley system is taken into consideration. But modern ideas triumphed, and another example is given of the all-absorbing spread of the electrical railway system, which has developed to such astounding proportions in the United States.

WHILE Mr. Haskins' entertaining article on "Telegraphing Forty-five Years or More Ago" will be read with especial interest by "old timers," who can recall the early days of telegraphy, it will not fail to attract the attention of every student who is interested in the development of the application of electricity to commercial work. In watching the progress that has been made in other directions many have lost sight of the numerous improvements and refinements that have been introduced in telegraphy, which have brought it from the crude, impracticable art of forty-five years ago to its present state of perfection. Mr. Haskins recalls several incidents illustrating the trials, the cares and the triumphs of the operator of those early days, which will be read with interest by the "cracks" of to-day.

THE destruction of the city lighting plant at Little Rock, Ark., the details of which are presented on another page, was an act of vandalism the like of which has seldom been equaled in this country. It is to be hoped that the miscreant who perpetrated the outrage will be speedily punished. While it is to be regretted that such an incident should be used for political purposes, as this apparently was, yet, in this case, the fact serves to demonstrate the absurdity of attempting to run a city lighting plant upon business methods. Politics will permeate every branch of the municipal service as long as the present system prevails. Those who are interested in the problem of municipal ownership of such enterprises should study this example carefully. The spectacle of a political boss passing judgment upon the ability of a man of recognized standing in his profession and pronouncing him "incompetent" is truly an edifying sight.

THERE have been an unusually large number of accidents on electrically equipped street railway lines during the last month; some, no doubt, unavoidable, but many evidently the result of carelessness on the part of those in charge of the motor cars. It is unjust, however, to charge these accidents to the trolley, for they would have occurred just as readily if any other form of power were employed in the propulsion of the cars; nor, on the other hand, should the advocates of the trolley system close their eyes to the fact that they should exercise every precaution to prevent these accidents. There is nothing in the electrical equipment of a street car to make it proof against collision or other accident, as some of the men in charge of the motor cars seem to think, judging from the reckless manner in which they handle the cars. The companies should exercise discretion in the selection of motormen, as the responsibility of the position is by no means light. Then, too, operating companies should take advantage of every improvement tending to safeguard the passengers. If they do not the public will not be long in losing confidence, and financial loss will ultimately follow this short-sighted policy.

In Orange, N. J., recently an accident occurred on a trolley road that was primarily due to a faulty brake, but was no less chargeable to the criminal carelessness of the men operating of the car. With full knowledge of the fact that the brake was not working satisfactorily, these men started the car down a steep grade with 60 passengers on board. Such gross carelessness is inexcusable, and should be promptly punished. The company will doubtless have heavy damage suits to face as a result of this accident, as eighteen passengers were very seriously injured.

ELSEWHERE in this issue is presented the full text of Judge Green's decision in the case of the Brush Electric company and others against the Electric Storage Battery company, in which an injunction is denied. There was much conflicting testimony presented in this case, eminent experts appearing for both parties, and the court concluded that their affidavits, which must of necessity be *ex parte*, could "only be productive of doubt." The existence of such doubt must, therefore, in the opinion of the court, make it impossible to issue the desired injunction. Another reason is presented in justification of this action, and this part of the opinion will be read with interest to those who are in no way affected by the present litigation. Judge Green called attention to the fact that where an injunction was asked for it should be shown that the plaintiff had displayed diligence in asserting and vindicating his rights. In the present case it was asserted that the defendant was permitted to establish and develop its business with full knowledge of the plaintiff and without the latter taking any steps to interfere or discourage the enterprise. The result was that the defendant assumed that it would not be molested. The excuses presented by the plaintiff were considered unsatisfactory by the court, which concluded that the defendant had reason to believe that no attack would be made upon it. It is held that "if the rights of the complainant have been invaded by the alleged infringing acts of the defendant it is scarcely an exaggeration to say that the dilatory conduct of the complainant in protecting its rights amounted to open encouragement of, or, at least, to silent acquiesence in, such invasion," and that "such conduct bars absolutely the remedy asked for at this time by the complainant."

PERHAPS the readers of this journal may not have heard of the magno-ora-conducto-distendo, or, hearing of it for the first time, may judge from the name that it is a child's toy. Let them not be too swift in their judgment, however, for the inventor, a Detroit dentist, claims to have a tiny instrument bearing that title which is a telephone for the transmission of thought and which may be operated for any distance without conducting wires. The invention of such a device is, of course, of some importance, and we regret that we cannot spread a detailed description of it on the pages of the WESTERN ELECTRICIAN. Authenticated facts in relation to the magno, etc., are, however, difficult to obtain. Indeed, we are not prepared to assert positively that it is an electrical device at all. The doctor is naturally averse to going into details before securing his patent, so we only know that the instrument consists of a coil of wire not bigger than a silver dollar. It is somewhat like a watch in construction, it is stated, and may be carried in the vest pocket. Dr. Payment—that is the name of the inventor—asserts, moreover, that the little magno is simple in construction and can be cheaply manufactured. As to the methods of operation the doctor makes this statement:

> The instrument has been tried and has done its work perfectly. There are no wires and no connections necessary. All you need is the magno-ora-conducto-distendo, and you can communicate with anybody on the face of the globe, providing the other party has an instrument. You don't have to take the instrument out of your pocket even. All that is necessary is to think of the person you want to speak to and the instrument will give an alarm and he will answer you. The conversation can be carried on very nicely, and every word will be as plain as if you were standing right in front of the person instead of 1,000 miles away.

Not unreasonably, the inventor expects a large sale of the instrument as soon as it is put upon the market. As will be seen, it solves the problem of transatlantic telephony at once, and will also be of marked assistance to the deaf and dumb. Telephone manufacturers, "hello girls" and wire manufacturers will frown down upon it, unless, indeed, the Bell monopoly should gain control of the magno and shelve. Of this we have some apprehension, but if this danger is averted there seems to be no reason why Dr. Payment's invention should not be ushered upon its interesting career. Means should be provided, however, by which each user can insulate himself from unwelcome thought-calls, else many annoying and confusing complications will ensue.

## Electric Railway Equipment of the South Side System, Chicago.

On Thursday of last week the Chicago City Railway company awarded to the Westinghouse Electric & Manufacturing company the contract for furnishing the electrical machinery for equipping its cross-town and auxiliary lines with electric power. This important contract comprises six multipolar generators of the standard Westinghouse type for street railway service, each of 700 horse power, and 128 double car equipments, each supplied with two 25 horse power motors. The Westinghouse company will also supply a switchboard extending the whole length of the power house at Wabash avenue and Fifty-first street, with a complete outfit of instruments, including a main ammeter reading up to 10,000 amperes. Several of the lines of the Chicago City Railway company, such as those on Sixty-first and Forty-seventh streets, have been for some time electrically operated from the Fifty-first street power house, where four 700 horse power generators are in operation. With the new machinery the total capacity of the station will thus be 7,000 horse power, making it one of the most important electric railway power houses in the country. All of the new equipment is to be set up and running within 150 days. The contract was taken for the Westinghouse company by Lemuel Bannister, general manager, and W. F. Zimmerman, assistant general manager.

The contract for the car controllers for the new equipment was given to the General Electric company. It calls for 240 series parallel controllers of the "K" type, to be delivered within sixty days.

It may be said that with the exception of the main arteries of the Chicago City Railway company's system on the South Side—the State street and Cottage Grove avenue cable lines—and of the Indiana avenue line, the change of motive power contemplated by this contract takes in practically the whole network of street car tracks on the South Side of Chicago, south of Twenty-second street. The ordinances authorizing this change—from animal to electric power—were first introduced into the city council about a year and a half ago. They passed but were vetoed by the mayor. After a varied experience the matter was still in an unsettled state when Mayor Hopkins took his seat. The ordinances were again passed this summer and Mayor Hopkins returned them with his veto to the city council. With his veto the mayor proposed a number of amendments. Alderman O'Neill moved to reconsider the votes by which the ordinances were passed, and this was done, and then the new ordinances, amended according to the suggestions of the mayor, were passed. These conferred the right on the Chicago City Railway company to operate by animal, electric or cable power a double-track railway on Halsted street from Sixty-ninth to Seventy-ninth streets, and to connect with its present line on Halsted street and the lines which it intersects. Lines were also authorized on Wallace street from Thirty-ninth to Root street, and from Forty-seventh to Sixty-third street upon Center avenue. On Twenty-sixth, Thirty-first, Thirty-ninth, Fifty-first, Sixty-ninth and Seventy-ninth streets electric power was permitted over the tracks of the company already established, and also on Archer avenue from the river west to the intersection of Thirty-eighth street, thence on Thirty-eighth street to the terminus of the tracks of the Chicago City Railway company on that street; Forty-third street from the eastern terminus of the tracks of the railway company on that street west to State street, thence along State street to Root, thence west along Root street to the terminus of the tracks of the company on that street. The change was also authorized on Halsted street from Archer avenue to the southern terminus of the tracks of the company on that street; Wentworth avenue from Archer avenue to the southern terminus of the tracks of the company on that street; Ashland avenue from Archer avenue to the southern terminus of the tracks of the company on that street; upon South Chicago avenue from Seventy-first street to Seventy-fifth street over the tracks of the company; along Hanover street (now called South Canal), Butler and Wallace streets respectively, over the tracks of the company and their connections; upon State street, from Sixty-third street south to its intersection with Vincennes avenue, and thence to the terminus of the tracks of the company on Vincennes avenue.

It will be thus seen that the improvement is an extensive one. The first of the new lines to be operated will be, it is said, that on Halsted street, from Sixty-ninth to Root streets. An ordinance was also granted for the substitution of electricity on the Indiana avenue line, but was subject to the consent of a majority of the property owners, which was not obtained.

## Destruction of the City Lighting Plant at Little Rock, Ark.

The city electric lighting plant at Little Rock, Ark., was disabled on Friday night, August 24th, by some unknown miscreant putting sulphuric acid on the commutator and armature coils of the dynamos. The plant was installed by the city at a cost of $30,000, and was considered a model plant. It had been in operation since May 7th, and was furnishing current to lamps for street lighting. Superintendent Fish furnishes the following statement of the trouble:

Friday about 9 A. M. I entered the plant as usual to inspect and see that everything was in order. When about ten feet from the dynamos I discovered something unusual upon the commutators and lower field coils of each dynamo that resembled dirty water and filth and had a smell of acid about it. Becoming convinced that it was acid, and that it must have been placed there, I called the chief of police, who reached the scene in about two minutes. As soon as he had looked the dynamos over and commenced to look for other evidence I undertook to remove the acid and its effects. The commutators being insulated with mica the acid could do them no harm, and an examination of the field coils under the commutators showed that the paint and shellac had protected them, as I thought; but upon looking over the fourth one I discovered traces of acid having been poured into the armature. This I wiped out and painted the parts with P. & B. By this time the chief had found evidence enough to convince him that it had been done by some outside person, and requested that nothing at all be said regarding the matter. Believing that the best policy in order to locate the culprit, and as I had not detected any grounds or other faults that would indicate a likelihood of any serious trouble, I readily consented; but during the entire day we watched things, and did all that seemed necessary to prevent damage. At starting time one of the dynamos showed a ground, and I apprehended trouble with it. As the others appeared none the worse for their treatment I started them one at a time on light load and watched the effects. In a few minutes they gave out, showing evidence of short-circuit, except the grounded one, which took up a second ground at once in the lower field, showing that it was affected in spite of the shellac. Upon taking down the dynamos and removing the commutators it was discovered that acid had been poured in from the rear and had taken a course forward under the head end canvas, meeting no obstruction such as shellac or paint. Upon separating the coils and testing I found that the two lower divisions of each armature were affected, some of the coils being grounded, while from four to six in each division showed short-circuits and contact with each other; this difficulty I proceeded to remedy by unwinding each coil below the acid effects and reinsulating and rewinding.

The reports made to me by the police from time to time were to the effect that the person who had wrought the injury had gained entrance through one of the windows and had, instead of coming up the railroad track, taken a course along the river bank, some 200 feet north of the station, and in doing so had left a well defined track, measurements of which were taken. A person answering the description of the one I suspected had bought sulphuric acid the night before in a drug store less than 500 feet from the station. He had asked for the cheapest kind, saying that he wanted it for a battery. He had acted so queerly in making the purchase as to cause comment among the clerks.

A former employe of the city was suspected of the crime and was arrested. Superintendent Fish was suspended by the mayor when the matter was brought to his attention. Mr. Fish, who was for several years connected with the Chicago Arc Light & Power company, was the city electrician of Little Rock. He is a practical electrician, a man of sterling worth and is highly esteemed by the electrical fraternity.

## Another Elevated Railroad in Chicago to be Electrically Operated.

The equipment of elevated railroads with apparatus for electrical power transmission is progressing in a satisfactory manner. A short time ago the WESTERN ELECTRICIAN printed the news of the awarding of the contract by which the new Metropolitan elevated railway on the West Side, Chicago, is to be electrically equipped—that event marking an era in "L" road construction. Now it is announced that in all probability another West Side elevated railroad—the Lake street line—will be transformed into an electric road as fast as possible. The road now crosses the Chicago river at Lake street and then turns south on Market, the down-town terminus being at the corner of that street and Madison street. It is now to be extended east from the river on Lake street to Wabash avenue and the whole system will be electrically operated. The company now has before it bids from the General Electric company for equipping the line. The present plans contemplate using the third rail system. The company will build no power house at present, but will take current either from the Chicago Edison company or from the power house of the West Chicago Street Railroad company. The bid of the General Electric company for equipping the road complete is $142,000. It is estimated by electrical engineers who have carefully gone over the present expenses of the road that the expense of operation will be reduced nearly $6,000 a month as soon as electric motive power is put in. The averaging operating expenses for the last three month shave been $30,133 a month, so that this reduction will be nearly 20 per cent. Since the present management took hold of the property, operating expenses have been reduced $5,000 a month, and it is believed that with the reduction which will follow the introduction of electricity and with the increased traffic which the down-town terminal will certainly bring, the road will be put immediately on a paying basis.

DESTRUCTION OF THE CITY LIGHTING PLANT AT LITTLE ROCK, ARK.—VIEW OF DYNAMO ROOM.

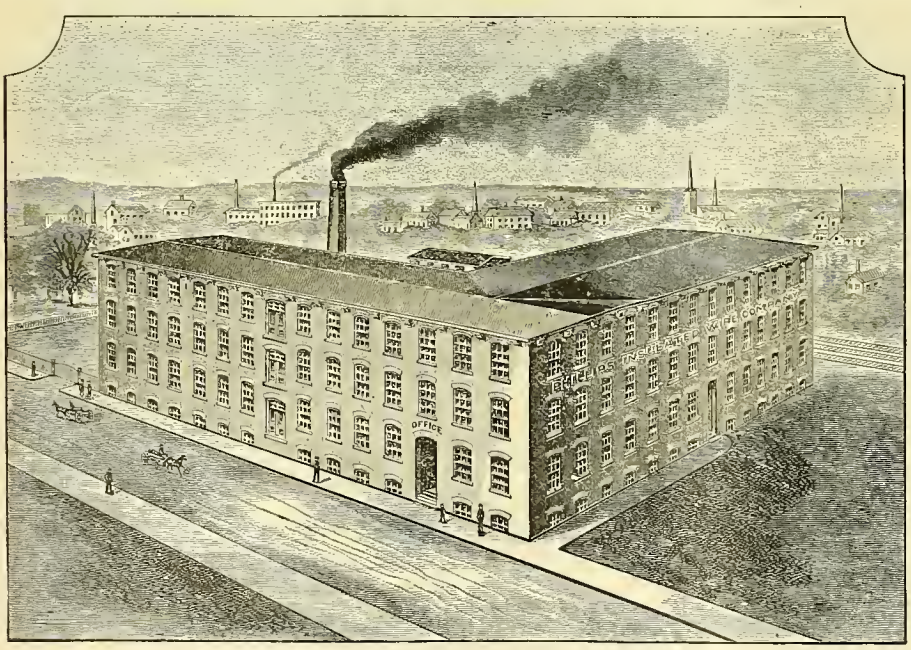
## Power House for the Metropolitan Elevated Road, Chicago.

The Metropolitan West Side Elevated Railroad company of Chicago, which is equipping its line for electrical power, is remarkably reticent in relation to its plans. It may be stated, however, that excavation has been begun for the power house on the line of the road between Throop and Loomis streets, just to the west of the old electric light station belonging to the city. The building will, it is said, be 600 feet long, 90 feet wide, and have an average height of 70 feet. Only one-half of this will be put up now, the other being added as the extension of lines demands an increase of power. The edifice will be of steel construction, with brick walls and slate roof, and will be fireproof. The cost, with the plant complete, will be about $800,000, and it is expected that the building will be completed December 1st. The engine room will be 300 feet long and afford space for eight large engines, and the boiler equipment will be in a separate house, and will consist ultimately of thirty-six boilers of 300 horse power each. Sixteen stations along the line of the road are nearing completion, while contracts have been let for fifteen others. The average cost of the stations is $11,000.

## New Factory of the Phillips Insulated Wire Company.

The Phillips Insulated Wire company is well known to electrical men by its tried product, "O. K." weather-proof wire, and it is now introducing a new wire insulation, "Ideal," which is made by taking the raw cotton fiber and applying it as a tape to the wire. This process admits of a most thorough saturation by the insulating compound, the particles of cotton becoming matted into one solid envelope about the wire.

The company's new factory at Pawtucket, R. I., is a model of its kind, and the laying out of the plant does great credit to Treasurer H. O. Phillips, who devised and superintended all the details. The building, shown in the cut, extends 186 by 50 feet on the ground and is three stories high, with a basement. It is of brick and has 36,000 square feet of floor surface. Power is furnished by a 100 horse power tubular boiler from the Bigelow works at New Haven and a 60 horse power Green engine. A plant of 200 incandescent lights will soon be installed. The offices are on the ground floor in the northeastern corner of the building, and telephones connect them with the different floors. Self-winding clocks, manufactured by the Self-winding Clock company of New York are placed on each floor, all electrically connected with a master clock in the main office. The heating is regulated by thermostats made by the Electric Thermostat company of Minneapolis. Throughout the whole establishment the idea of having each department in constant touch with the office is apparent.

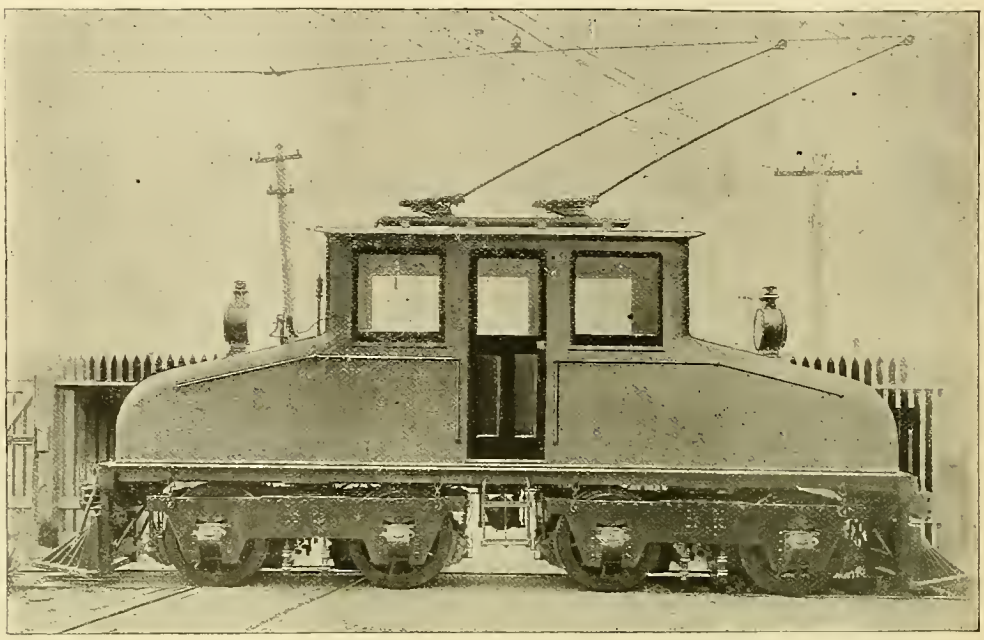



NEW FACTORY OF THE PHILLIPS INSULATED WIRE COMPANY.

The company enjoys excellent freight facilities, the East Providence branch of the New York, New Haven & Hartford railroad passing directly in the rear of the factory, and a spur track from it running to the shipping department. The company owns considerable surrounding property, which is held in reserve for building facilities if the necessity arises for still further enlarging the plant. The New York office is in charge of H. C. Adams, president of the company, and the Electric Appliance company of Chicago is the western agent.

## Forty-ton Electric Locomotive.

Among electrical exhibits at the World's Fair that attracted general attention was a thirty-ton electric locomotive built by the General Electric company. From thirty tons and one two-motor truck to forty tons and two two-motor trucks is a considerable advance. The General Electric company has recently completed a locomotive of this description at Lynn, and, as will be seen by the accompanying illustration, it is an imposing electrical engine. It is designed to perform the ordinary work of a steam locomotive of similar capacity where excessive speeds are not considered requisite, up to about thirty miles an hour. It is made up of two similar but independent trucks, each having four wheels. Each pair of wheels is driven by its own specially designed motor of the single reduction spur geared type, mounted upon the axle as in ordinary street car practice.



FORTY-TON ELECTRIC LOCOMOTIVE.

The truck frame is constructed of plate iron and channels designed to obtain at the same time both strength and simplicity. The entire weight of the frame including the cab is carried on elliptical springs resting directly on the top of the journal boxes. This suspension secures easy riding and minimizes the wear both of the locomotive and the truck. The journal boxes are of cast-iron with phospor-bronze bearings hydraulically pressed in. Lubrication is provided by means of a large well for oil and waste. The box slides in jaws protected by adjustable shoes to take up the wear. The journal bearings beings outside, all parts are easily accessible for purposes of inspection and repair, and to insure against any bending caused by hard usage the axle and journals are made large.

The cab rests on the truck in a manner somewhat similar to that in which the ordinary passenger car is mounted, an ample margin for wear and strength being provided. The cab itself is constructed of sheet iron, and the windows in it are so arranged as to give an almost unobstructed view from one position in all directions. The design of the cab is such as to give plenty of available floor space without making the top of the cab long enough to obstruct the sight. The design of the cab also makes a symmetrically shaped locomotive.

The electrical equipment comprised besides the motors a series parallel controller, an air compressor, which provides air for the brakes and whistle, and the automatic safety devices. In addition there are bells, headlights and sand boxes. The dimensions and features of this locomotive are as follows:

| | |
|---|---|
| Weight | 40 tons |
| Drawbar pull | 14,000 pounds |
| Height over all | 11'2 |
| Length over drawbars | 24' |
| Width over all | 8 4" |
| Wheel base of single truck | 6' |
| Diameter of drivers with 3" steel tires | 40" |
| Number of drivers | 8 |
| Size of journals | 4½x8" |
| Gauge | 4 8½" |

## Electrical Power from the Falls of Montmorency.

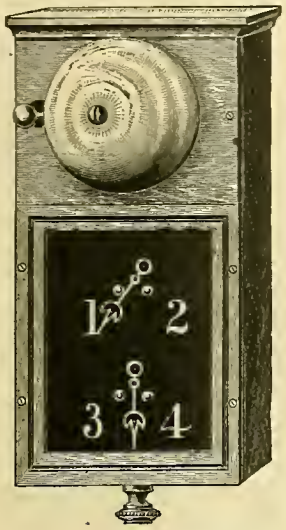
The far-famed Falls of Montmorency, near Quebec, have been utilized for some time in supplying electricity for light and power to the walled city. The total descent of water at this beautiful cataract is over 300 feet, there being one perpendicular fall of 268 feet. A straight alternating current has been used, but the Montmorency Electric Power company recently decided to make a change in its plant, and has contracted for three of the new Stanley two-phase generators, each of 675 horse power capacity. These machines will deliver current at a potential of 5,500 volts, and the output of each dynamo will be carried on four wires to a sub-station in Quebec, where step-down transformers will reduce the pressure to 2,000 volts, and the distributing system through the town will be at this potential. The Stanley company is furnishing 1,000 kilowatt capacity of step-down transformers for this purpose, which will be placed in a sub-station built especially for this use, with very complete arrangements for keeping the transformers cool by air blasts. The current will be used for lighting, general power distribution by two-phase alternating current motors and for running the street railway by use of rotating transformers. In the sub-station there will be also a very complete switchboard installation. There will be one switchboard for the railway service, another for the arc light circuits and a third for the two-phase light and power service. The offices of the company will also be in the same building. The drop in the line between the fall and the sub-station is calculated to be 6 per cent.

F. H. Badger, the general manager and electrical en-

gineer of the company, is a son of the city electrician of Montreal, and was with the Royal Electric company of Montreal for ten years. He connected himself with the Montmorency company in February of this year, and it is to his engineering skill and able management that the plant under consideration is largely due.

## New King Annunciator.

The new King annunciator of the Partrick & Carter company of Philadelphia, illustrated by the accompanying cut,




NEW KING ANNUNCIATOR.

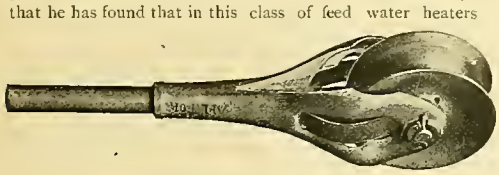
is made in four sizes—two, four, six and eight calls. The bell movement is the same as in the wood box bells put out by this company, and the bell is removable, so that the working parts can be readily examined without taking the annunciator from the wall. The instrument is made with oak or walnut cases and a glass front. It is well finished and efficient in operation.

## Trolley Harp and Wheel.

The trolley harp and wheel illustrated herewith is made of the best malleable iron and the highest grade bronze, with steel tang. The crescent section of the side-bars adds strength to lightness, and affords a rounded surface which will not catch or dent the trolley wire. It is shaped to give ample room for the edges of the wheel and perfect protection to the contact springs. The pin is fastened by an improved method, giving a large bearing and avoiding sharp corners. The metal is so distributed in the body that the wheel may be entirely worn out and the wire can never be worn by coming in contact with the harp, which is a great advantage. The wheel is designed to give the greatest possible amount of service. The desired result is obtained by using the highest grade of bearing bronze and in the proper distribution of the metal. Some of these wheels are still in service, it is said, after making the phenomenal record of ten thousand miles. This is one of the specialties of the Hubley Manufacturing company, Lancaster, Pa., which manufactures complete equipment for electric railway and lighting plants.

## Feed Water Heater and Purifier.

Several new features have been introduced in feed water heaters and purifiers by Warren Webster of Camden, N. J. The latest of these are embodied in a device recently perfected, which is herewith described. Mr. Webster says that he has found that in this class of feed water heaters



TROLLEY HARP AND WHEEL.

and purifiers at certain times when the supply of steam is limited and insufficient in volume to heat the inflowing water to the highest temperature, the air which is expelled from the water accumulates in the top of the heating and purifying chamber and renders the device inoperative until the air is removed, thus requiring a pressure of steam to enter the chamber at intervals at a pressure in excess of that of the atmosphere, so as to expel the air through the overflow or relief pipe, and thus make room for the steam. In order to obviate the necessity of requiring steam to enter at a pressure in excess of that of the atmosphere, and to get rid of the air as rapidly as it is liberated from the water, together with being able to use steam at a pressure less than that of the atmosphere by maintaining a partial vacuum within the feed water heater, a suitable suction or air-withdrawing device is employed, which is adapted to be positive in its action, and capable of being operated at will independently of any other discharging pipe. This device connects with a pipe communicating with the inside of the chamber above the water line, so as to obtain the amount of suction necessary to withdraw the air and maintain a partial vacuum within the heater if desired.

Fig. 1 represents a partial side elevation and a partial vertical section of the Webster feed water heater and purifier, while Fig. 2 represents a side elevation at a right angle to Fig. 1, and Fig. 3 represents a modification of the air exhausting device. Referring to the illustrations, *A* designates a feed water heater and purifier consisting of the chamber *B* with the water supply *C*, the steam inlet *D*, the outboard water delivery pipe *E*, the spraying device *F*, the metal distributing plates *G*, the condensing tubes *H* and gravity regulator *J*. Connected with the chamber *B* and communicating with its interior is an air pipe *K*, having an automatic air inlet valve *K'*. To the pipe is attached a suction exhaust or vacuum-creating device, which is an air injector as at *L* in Fig. 1, or a pump as at *M* in Fig. 3, the result being similar in either case, in that the air is withdrawn from the chamber *B* and the heater and purifier is adapted to work effectively. The improvement is in fact a development of Mr. Webster's system, which is already well known to mechanical and electrical engineers.

## Storage Battery Litigation.

The text of Judge Green's decision in the United States Circuit Court, District of New Jersey, in the case of the Brush Electric company and others, against the Electric Storage Battery company and others referred to last week, in which the plaintiffs' application for an injunction was

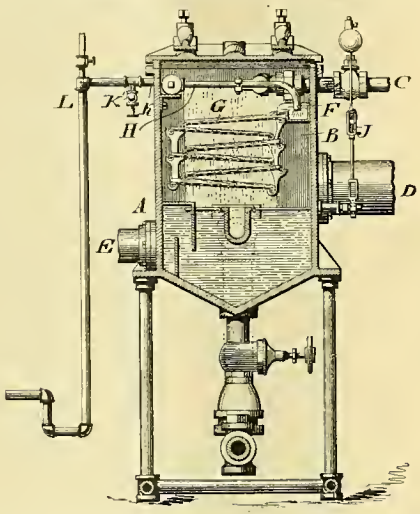



FIG. 1. FEED WATER HEATER AND PURIFIER.

denied, will be of interest to those interested in storage battery litigation and is herewith presented:

Two reasons conjointly compel a denial of the motion for a preliminary injunction, made by the complainants.

The validity of the letters patent in question is beyond dispute. They have been sustained by all the courts before which they have been the subject of litigation. The only question to be considered upon this motion, under the circumstances, is that of infringement. While it is well settled that a preliminary injunction will issue almost as a matter of course, in any given case wherein the defendants are shown to be guilty of infringement, after an adjudication establishing the validity of the letters patent involved in the litigation, yet it is equally well settled that to warrant and justify the exercise of this extraordinary power, the proof of the alleged infringement must be clear and decisive. Equity peremptorily insists that such action, so drastic in its effects, shall be taken only in those cases wherein a clear, unclouded, equitable right to the interference of the court is shown; in all other cases the demand is to be met by refusal. Otherwise unfair prejudgment may result.

In the case at bar the proof of infringement fails to attain to this standard. It is quite true that, on the part of the complainants, certain gentlemen, most eminent in their profession, and whose opinions, as experts, are entitled to great weight, have not hesitated, in their affidavits presented to the court upon this motion, to assert quite positively that not only the storage battery manufactured by the defendants, but as well the process used in the manufacture, do without doubt infringe some, if not almost all, of the claims of the letters patent under consideration; and they laboriously strove to justify the opinions so expressed, first, by giving to the letters patent and the various claims an exceedingly broad construction; and, secondly, by basing such broad construction upon a yet broader construction of the legal conclusions of the learned judges who have in past litigations defined and characterized the inventions of Faure and Brush.

Giving full weight to the opinions of these witnesses, elucidated and most eloquently enforced upon the attention of the court in the exceedingly able argument of counsel, it still remains to be said that the defendants have, in opposition thereto, presented opinions of other scientists, equally as learned and of equal standing and repute in the scientific world, which are directly antagonistic thereto, and by which they most distinctly and positively declare that in their judgment neither the process pursued by the defendants nor the completely manufactured battery impinges in the slightest particular upon those secured to the complainants by their letters patent. And so upon the one side are found the concurring opinions of Prof. Morton and Prof. Chandler, Prof. Houston and Dr. Barker; upon the other, those of Prof. Brackett, Prof. Cross, Prof. Thomson and Mr. Van Size. These are gentlemen of unquestioned veracity, thoroughly understanding the subject matter under consideration; stating opinions with confidence which they be-

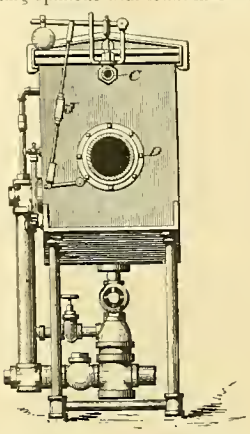



FIG. 2. FEED WATER HEATER AND PURIFIER.

lieve to be well formed, and yet they arrive at conclusions which are irreconcilably and diametrically opposed. It must be apparent that affidavits of this character, *ex parte* as they are, can only be productive of doubt. When the statements so made and the opinions so expressed come to be tested by a severe and thorough cross-examination, beyond question those which show themselves securely founded upon reason and fact will be immediately accepted and concurred in. But until then, the existence of a doubt, well founded and reasonable, as to the right of the complainants to the remedy they ask, cannot be overlooked. The existence of such doubt must now, at least, control the action of the court. It is fatal to a motion for a preliminary injunction to justify the interference of a court of equity, *pendente lite*, by way of an injunction; the actual or threatened infringement of a right must appear as clear as the noonday sun.

There is another reason why this motion must be denied. Equity demands of a complainant that he should display great diligence in the assertion and vindication of his rights. Inexcusable delay on his part, though it may not amount to conclusive proof of acquiescence, nevertheless may be and often is sufficient cause to disentitle him to the summary interference of the court on his behalf by way of interlocutory injunction. Whatever may be the original equities of the case, as between the parties, if the complainant stands quietly by, without seeking to enforce his rights, while the defendant expends time and labor and money upon the enterprise sought to be enjoined, upon faith that no actual or effective objection thereto will be made, he will be shorn of any right to appeal to the court of equity for assistance. (Hummer v. Hummer, 2 Green (Ch,) 263; Whitney v. Union 6, 11 Gray, 359; Carlisle v. Cooper, 21 N. J. Equity, 599). In other words the principle has been thus stated: No one can have relief if his own conduct has led to that state of affairs which occasions the application.

The proofs submitted to the court on this motion shows these facts. The defendant corporation was organized under the laws of the state of New Jersey in 1888. Its sole purpose was to engage in the manufacture and sale of electric storage batteries, of the type known as the chloride accumulator. Its works were located at Gloucester in this state; and from the time of its incorporation to the present, it has carried on its business without interruption. Its existence and the character and extent of its operations were well known to the principal officers and managers of the complainant corporation. In the conduct of its business

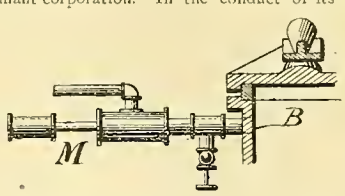



FIG. 3. FEED WATER HEATER AND PURIFIER.

at various times, and especially in 1891, 1892 and 1893, the defendant openly installed storage battery plants of the alleged infringing type in various public buildings and for various corporations. Thus, for example, they furnished plants or batteries to the Provident Insurance company of Philadelphia; to the Metropolitan Railway company of Washington; to the Union Square theater in New York, and elsewhere. The fact that these plants were furnished by the defendants was well known to the complainants. Besides, early in 1893 the defendants issued a pamphlet in which was printed an opinion of Prof. Chandler, of Columbia College, on storage batteries, and which contained a detailed and correct statement of the mode of construction and operation of the storage batteries of the defendants, and a full and succinct comparison between them and the batteries of the complainants. This pamphlet was widely circulated, and admittedly the complainants knew of it.

In July, 1893, the defendant, through its president, sent to the complainant corporation a letter in which, among other things, is the following statement and appeal:

PHILADELPHIA, PA., July 27, 1893.

*Mr. William Bracken, president Consolidated Electric Storage company, New York, N. Y.:*

DEAR SIR: I am favored with copies of your letters of 27th February and the 24th of July, 1893, to George W. Pearson, president of the Metropolitan Railway company of Washington, D. C., wherein you state that the battery manufactured by the Electric Storage Battery company of Philadelphia is a clear infringement of the Brush patents, and of which "there is no earthly doubt."

* * * * * * * * *

By what authority do you say our battery infringes the claims of your Brush patent? Surely on the authority of no court, for you well know that no court has declared our battery to be an infringement, and although we have been to your knowledge openly engaged in manufacturing our batteries for some years, you have not down to this moment proceeded against us, although threatening to do so for nearly eight months past. You apparently propose to dispose of our battery and business without even resorting to the courts wherein such questions are usually determined.

* * * * * * * * *

Unlike you, we have sufficient confidence in our position to submit the question to the courts empowered to consider and determine such questions, and there we invite you to meet us at once, and unless you do so or discontinue your libelous statements against our battery we will take such steps as we are advised are open to us to protect our interests.

We are advised by our counsel and experts that our battery does not infringe any of the claims of your patents and having confidence in their opinion, we propose to continue making and selling our battery, and shall protect and save harmless all users of them not only as against any claim you may make, but against all claims from whatever source.

Now, being advised of our intentions we demand in view of statements made in your letter to Mr Pearson and other parties, that you proceed at once against us on a bill of infringement accompanied with motion of injunction so that the question of our infringement of your patents may be determined, and to that end we advise you viz.:

We are a New Jersey corporation with a factory at Gloucester in that state where batteries are being manufactured daily and we will at any time furnish you with one of our batteries at the usual price, accompanying same with a sworn statement of precisely how they are made, with permission to use the same in any proceedings against us.

We have, to avoid delay authorized our counsel, John R. Bennett, Potter building, New York city, to accept service papers in our name and to aid you in every way possible to reach the courts at the earliest possible moment and you can arrange with him either direct or through your counsel for one of our batteries and a statement of its construction.

If you have confidence in your position you will of course accept our most reasonable proposition to proceed against us at once, and if you do not we hereby notify you that we shall proceed against you to protect our interests, holding you responsible for the damage resulting to our business by the making of statements and the sending out of such unfounded libelous letters as you have sent to Mr. Pearson.

To this letter the complainants returned no answer beyond a mere acknowledgment of receipt; and, admittedly took no action toward the assertion of their claim until months after.

In the meantime the defendants, assuming, as it cannot be denied they had reason to do, that no attack was to be made upon them, increased their capital stock $250,000, and proceeded to erect in addition to their existing factories a very extensive plant, at a very large cost. It was not until 1894, months afterward, that this bill of complaint was filed. Realizing the necessity of making explanation of their delay, the complainants allege that it was caused first by their diligent searching for some purchaser of the defendants' storage battery within the jurisdictional limits of the Circuit Court of the United States for the District of Southern New York, in which forum much of the previous litigation concerning the Brush and Faure batteries had taken place, and so avoid by the bringing of their suit in that jurisdiction some of the trouble and labor which would necessarily follow the commencement of a suit in this jurisdiction; and, further, that all the operations of the defendants were considered by the complainants to be simply tentative in the line of producing a practical commercial storage battery, and only an effort on the part of the defendants to persuade the complainants to spend thousands of dollars in substantially a moot litigation, to stop the making and sale or use of only a few batteries; and because the complainants believed the venture of the defendants was destined to be a failure and die a natural death.

It is hardly necessary to say that such excuses do not justify the laches of which the complainants have been clearly guilty. If the rights of the complainants are now trespassed upon by the defendants, they were in like manner trespassed upon more than four years ago; and the trespass, of which so loud complaint is made now, has been continuous. For reasons satisfactory to themselves the complainants, well aware of these continuous trespasses, chose to stand by, without taking action looking to the vindication of their rights and the prompt punishment of the trespasser. The result of such inaction on the part of the complainant is found in the increased contribution to the capital stock of the defendant corporation of hundreds of thousands of dollars, and the expenditure of an exceedingly large amount of money in the erection of a greatly extended plant. If, in fact, the rights of the complainants have been invaded by the alleged infringing acts of the defendants it is scarcely an exaggeration to say that the dilatory conduct of the complainants, in protecting their rights, amounted to open encouragement of, or, at least, to silent acquiescence in, such invasion. Such conduct bars absolutely the remedy asked for, at this time, by the complainants. (Brisbin v. Burdick, 12 Beavan, 1; Smith v. S. W. Railway Co., Kay 417.)

It was admitted upon the argument that the defendants were financially responsible, and amply able to respond to any award of damages that might be made against them. Under all the circumstances and for the reasons given the motion for a preliminary injunction is denied.

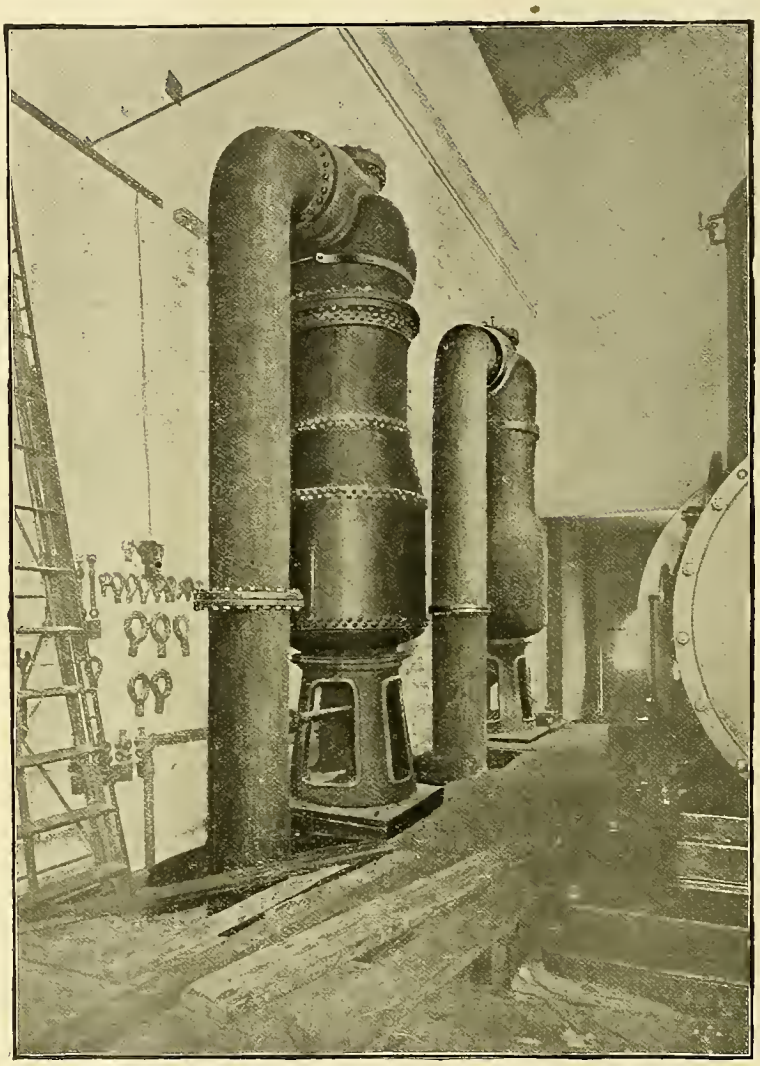
## Enterprise in Trade Journalism.

From *Electrical Engineering.*

How many trade journals exhibited the same enterprise in illustrating the many features of the World's Fair that the electrical press did? Complete files of all the electrical publications are not at hand, but an idea of what was done in this line may be inferred from the statement that prior to the opening of the gates the WESTERN ELECTRICIAN presented more than one hundred illustrations of buildings, the grounds and methods of construction, and more than double that number may be found in its pages following the opening, a majority of which represent different electrical and mechanical exhibits.

## Large Stratton Separators for the Philadelphia Traction Company's Plant at Philadelphia.

The accompanying illustration shows two of a total of six Stratton steam separators, all of more than usually large size, recently furnished by the Goubert Manufacturing company, New York, to the Philadelphia Traction company for the latter's new power stations at Thirteenth and Mount Vernon streets and Thirty-third and Market streets, Philadelphia. The Goubert company is noted for the number of large separators and feed water heaters it has built, and this installation takes rank with any already noticed, if indeed it does not exceed in the individual size and aggregate number all previous installations. Of the six Stratton separators in the Philadelphia plant two are 18 inch, two 16 inch and two 8 inch. One of the 18 inch separators is seen in the foreground of the picture.



LARGE STRATTON SEPARATORS FOR THE PHILADELPHIA TRACTION COMPANY'S PLANT AT PHILADELPHIA.

The wide adoption of the Stratton separator by large electric lighting and power companies lends more than passing interest to a brief review of its construction and claims to merit as a saving agent wherever steam power is employed. The Stratton steam separator is based upon the principle that if a rotative motion is imparted to the steam all the liquid particles, being heavier than the steam, acquire centrifugal force and are projected to the outside. It consists of a vertical cylinder, with an internal central pipe extending from the top downward for about half the height of the apparatus, leaving an annular space between the two. A nozzle for the admission of the steam is on one side, the outlet being on the opposite side or on top as may be most convenient in making the connections. The lower part of the apparatus is enlarged to form a receiver of considerable capacity, thus providing for a sudden influx of water from the boiler. A suitable opening is tapped at the bottom of the apparatus for a drip connection, and a glass water gauge shows the level of the water in the separator at all times.

The current of steam on entering is deflected by a curved partition and thrown tangentially to the annular space at the side near the top of the apparatus. It is thus whirled around with all the velocity of influx, producing the centrifugal action which throws the particles of water against the outer cylinder. These adhere to the surface, so that the water runs down continuously in a thin sheet around the outer shell into the receptacle below, while the steam, following a spiral course to the bottom of the internal pipe, abruptly enters it, and in a now dry condition passes upward and out of the separator, without having once crossed the stream of separated water, all danger of the steam taking up again such water after separation being entirely avoided.

It is of interest to add that the Goubert Manufacturing company has also supplied feed water heaters aggregating 12,000 horse power for the new plant of the Philadelphia Traction company.

## Voluntary Receivership for H. Ward Leonard & Co.

H. Ward Leonard & Co. announce that they have voluntarily gone into the hands of a temporary receiver. H. Ward Leonard has been appointed temporary receiver for New York state, where the most important assets of the company are located. The receivership was the result of a friendly suit brought by the Interior Conduit & Insulation company at the request of H. Ward Leonard & Co., and the bill shows assets amounting to about $177,000 and liabilities amounting to about $62,000; $109,000 of these assets have been locked up in a suit against the Cayadutta Electric Railway company for over a year past, and are likely to be for several months to come. H. Ward Leonard & Co. being a foreign corporation and subject to attachment, the directors deemed it best for the interests of the creditors and stockholders to place the affairs of the company in the hands of a receiver until the settlement of this suit, when, it is claimed, there will be not only ample assets to settle all claims in full, but abundant means for the stockholders to resume business with.

An electric lighting company has begun operations at Middletown, O. William H. Drayer is the secretary of the new company.

## Chloride Accumulators in England.

Readers of this journal who saw the description some months ago of the operation of three of the street railroads of Paris, France, by chloride accumulators, will be interested to learn that the Chloride Electrical Storage Syndicate, Limited, sole manufacturer in Great Britian of the chloride accumulator, is now operating the street railroads of Birmingham, England, with chloride accumulators, replacing the Epstein batteries, which were formerly in use. The chloride cells operate at least 60 miles on every charge, and it is claimed could do 80 miles if necessary, thus enabling each car to be operated with one set of batteries instead of two, as has been the practice heretofore. The English chloride company has also supplied batteries to Mather & Platt for use on the trolley road on the Isle of Man running between Portevada, the Douglas terminus, and the Laxey terminus. The *Electrical Engineer* of London says: "One of the most noteworthy features in connection with the line is the use of accumulators. At Groudle Glen, situated two and a half miles from Douglas, a battery of 240 cells has been erected in a building especially constructed for the purpose. These cells were manufactured for Mather & Platt, Limited, by the Chloride Electrical Storage Syndicate, Limited, of 16 Victoria street, London. They have a capacity of 140 amperes for three hours, or 70 amperes for nine hours, and are remarkable for the exceedingly level curve electromotive force which they maintain up to the end of discharge, and for the very high rate at which they can be discharged without detriment. Half the cells of the battery are of the Chloride company's patent protected type, with teak separators and asbestos diaphragms similar to those now being used on the Birmingham tramways, and the other half unprotected, The cells are charged direct from the line or from a motor generator, which is of special design by Mather & Platt, which gives the required additional electromotive force. This is the first instance of accumulators being used as a fixed battery for tramway or railway work in this country, although a similar step has been taken in the case of the Zurich Hirslanden tramway referred to in the *Electrical Engineer* of July 20th, last. The battery at Groudle Glen serves not only the function of supplying the extra power required at times of maximum demand, but it is intended during the winter months to work the light cars, which will then be sufficient for the traffic after the close of the tourist season, entirely from the battery, which will be charged only once or twice a week, as occasion may require."

The same company recently equipped the electric launch Aphrodite, the following description of which is taken from the London *Electrical Review* of August 17th: "On Saturday last the Goring-on-Thames regatta was held, and the new electric launch Aphrodite was lent to the Thames Conservancy for the occasion, and was employed for clearing the course during the day. This boat was built at Goring in A. C. Sander's boat yard. The arrangement of the electrical details has been carried out by H. A. Earle of Mather & Platt, Limited, 16 Victoria street, Westminster, and the novel feature consists in the employment of a battery of chloride cells for the first time on the Thames. They are manufactured in England by the Chloride Electrical Storage Syndicate, Limited, 16 Victoria street, London, and this launch has been especially built in order to demonstrate their superiority for this class of work, their large capacity for a given weight enabling distances and speed to be run without recharging which were previously impossible. The cells with which the Aphrodite is fitted are capable of being discharged at a very high rate, and, on the measured mile, a speed of nine miles per hour has been obtained, and this rate can be continuously maintained for about three hours, which is a record performance for an electric launch of this size; at slower speeds, namely, 6½ miles per hour, which is the usual rate of travel, and which is still considerably above the average speed of electric launches of this size, a day's run of nine hours can be undertaken, inclusive of the time taken through locks. One feature of the chloride cells is that although at very high rates of discharge their capacity for a given weight greatly exceeds that of other types, their increased capacity at low rate is still proportionately greater, and on this account, with the reduced speed of 5 1-2 miles per hour, the battery power with which this launch is provided is capable of covering a distance of approximately 110 miles without recharging."

# CORRESPONDENCE.

## New York Notes.

NEW YORK, September 3.—Considerable attention has been attracted by the cable repair ship Mackay-Bennett, belonging to the Commercial Cable company, which is now at anchor off Liberty Island. The mission of the ship is to lay cable to this city from Coney Island, where the cable from Waterville, on the southwest coast of Ireland, ends. The city station will be in the neighborhood of Pier A. This cable runs from Waterville to Canso, Nova Scotia, and thence to Coney Island. The new extension is a four-cored cable, with an outside diameter of about two inches and some fourteen miles in length. It weighs fifteen tons to the mile and was laid in the channel from the Narrows up to the city. This line was chosen as offering the least danger of injury from the anchors of ships. The Mackay-Bennett is stationed at Halifax and is detailed to attend to the cable lines that cross the banks, which are most frequently in need of her services. She was built at Glasgow in 1884 and is 270 feet long, 40 feet wide and with a depth of hold of 26 feet. What is most unusual in her appearance are two structures that overhang her bow and stern. These are immense sheaves and strong platforms built outboard to guide the line of cable as it comes from the tanks and glides overboard. A careful lookout is stationed on the platform to scrutinize every foot of the cable and see that it pays out correctly. The steamship has a rudder at each end, so that cable may be laid by either bow or stern. The Mackay-Bennett has a round bottom with no keel, so that in paying out over the bow all possibility of interference with the cable below the surface is avoided. The cable, of which there is now 180 miles aboard the steamship, is stored in large circular tanks or compartments capable of holding 300 miles. From the center of the tank rises a conical steel structure, ten or twelve feet in diameter at its base. About this, and resting on the flooring of the tank, the cable is coiled. When the line is to be paid out its end is passed up from the tank through a bell-mouthed thimble or fairlead. This guides it to another leader to the right, through which it passes and thence to the drum of the engine, which regulates the speed at which it leaves the ship. In this manner it is practically impossible for the cable to become kinked or tangled, and a constant check can be had upon it. In the forward part of the deck house is the testing room filled with electrical apparatus for locating breaks. This is done by means of a wheatstone bridge that measures the resistance of the cable when a current is passed through it. As the resistance of the whole line is known a smaller resistance indicates a break somewhere and the distance of the break is calculated proportionately. The deck of the Mackay-Bennett is taken up here and there by the huge black buoys used to designate the end of a broken cable while the splicing of a new line to the other end is being done.

Work on the new trolley road of the Nassau Electric Railroad company, on Marcy avenue, Brooklyn, has been stopped, pending a decision on a point of law. It is alleged by the officers of the road that consent of the property owners should be based on the assessment rolls of 1892, which was the year immediately preceding the granting of the charter. Several property owners have objected to this, and insist that the consent of property owners should be based on the assessment of 1894. Residents who own property valued at $400,000 have declined to give their consent to the road. The question has been referred to the office of the corporation counsel, and pending a legal opinion from that official Commissioner White has revoked the permit for building the road.

R. T. Wilson & Co., bankers of this city, have, after several months of negotiation, purchased the property of the Detroit Citizens' Street Railway company, holding a large majority of the stock under the terms of a contract made by the old company with Thomas Nevins of Orange, N. J. The option under the Nevins contract would have expired on Saturday, but the final details were not arranged until long after banking hours. The consideration for the stock purchased is not stated, but it is believed to be upward of one-half million dollars, beside which the purchasers relieve the company of a considerable outstanding indebtedness. New directors were elected, and J. M. Edwards of New York was elected president and R. T. Wilson of New York treasurer.

It is stated that the directors of the Long Island Traction company have decided to issue collateral trust notes paying six per cent. interest and having a face value of $3,000,000. It is alleged that a syndicate has already signified its intention to purchase $1,875,000 of the issue at 80. Traction stockholders will be permitted to purchase at 85. The company controls the entire Brooklyn City railroad system. It is claimed that the new loan will be well secured. The money is needed to extend the lines. There are between eighty and ninety miles of extension at the company's disposal and work will be started soon. The Traction company has authority to make its system half as large again as it is.

W. F. O.

## PERSONAL.

D. H. Hemingray of the Hemingray Glass company, Covington, Ky., has been in Chicago for several days.

George A. McKinlock, president of the Central Electric company, has returned to Chicago after a few days of recreation.

Prof. George D. Shepardson of the electrical department of the University of Minnesota was in Chicago for a few days last week.

H. C. Whitney has resigned his position with the Interior Conduit & Insulation company, with which he has been connected as motor salesman for the last six months.

The funeral services over the remains of the late George B. Shaw were held at the family residence in Eau Claire, Wis., on Wednesday of last week. They were very largely attended and a delegation from Congress was present.

William F. Cullen of New York, who died recently in Colorado, was connected with the E. P. Gleason company for twenty years. He had a wide acquaintance among eastern electrical men, especially those engaged in the fixture trade, and was highly esteemed.

The friends of Albert A. Carey of the Abendroth & Root Manufacturing company, New York, will be pained to learn that he has been seriously ill for several weeks with appendicitis, and was recently obliged to undergo an operation. He is at present doing nicely and it is expected will be out again within a few days.

## NEW INCORPORATIONS.

Consumers' Electric Light company, Pana, Ill.; capital stock, $5,000; to supply electric light and power; O. H. Paddock, Pana, Ill.

## TRADE NEWS.

Ward Wilkins of the Partrick & Carter company of Philadelphia is arranging to start on an extended business trip through the South and West.

A. Bononville of the Alfred Moore company of Philadelphia has returned from a pleasure trip through Canada. The outing has evidently been of great benefit to him.

J. G. High of 123 North Third street, Philadelphia, is very busy in getting out a number of switchboards for important installations near Philadelphia. He has a large number of orders for his new 500 ampere switch.

President F. S. Marr of the Helios Electric company of Philadelphia has been making a rapid business tour of the West, returning with a number of large contracts. He says there is a revival of business in all places where he visited.

Recent tests made on three sizes of Lundell fan motors at the factory of the Interior Conduit & Insulation company, 527 West Thirty-fourth street, New York, gave the following results: No. 560—Speed, 1,732; volts, 114.96; amperes, 0.44 5-6. No 562—Speed, 1,422; volts, 114.7; amperes, 0.84¼. No. 568—Speed, 116.16; volts, 114.89; amperes, 1. Twelve motors of each size were taken from stock at random, and the figures given are the mean of the twelve in each case.

The popularity of the Allen soldering stick seems to have no bounds, judging from the sales the Electric Appliance company is making in all parts of the country. The demand for this specialty in the East is very large, and the Electric Appliance company is making shipments in considerable quantities to Boston, New York, Philadelphia and other eastern points. The Arnold telephone also seems to be satisfying the demand for a first-class magneto telephone, and many eastern as well as western orders have been booked.

Geo. A. McKinlock, president of the Central Electric company, 173–175 Adams street, Chicago, states that his company has purchased the entire electrical house goods stock of the Detroit Electrical Works. This he has had moved to the Chicago store of the Central Electric company, where it will be disposed of in lots to suit purchasers and at prices that will have a cheering effect on the heart of the most pessimistic croaker. Mr. McKinlock says that it is the cleanest and best stock of electrical house goods that it has ever been his fortune to buy. The bells, batteries, annunciators and pushes are all standard goods of the latest and best designs. The company has issued a complete list, quoting prices.

## BUSINESS.

A nicely gotten up catalogue of some of the latest electrical specialties will be cheerfully sent on request to the Washington Electric company, 205–207 South Canal street, Chicago.

The Phosphor-bronze Smelting company of 2200 Washington avenue, Philadelphia, has issued a convenient price-list of its goods, including its line of wire, which will be sent on application.

President F. A. La Roche of the La Roche Electric works of Philadelphia recently closed a contract with the light and power works of Hartford, Conn., for one 350 horse power generator for its plant, and later this order was duplicated.

General Manager C. E. Trump of the Novelty Electric company, Philadelphia, reports a general improvement in business. The company has kept all hands at work and is preparing a number of electrical devices which will be placed upon the market later in the season.

The General Electric company has through its St. Louis office sold to the Citizens' Railroad company 60 G. E. 800 equipments and to the St. Louis Railroad company for the Seventh street line 20 G. E. 800 equipments; also to the new Union station (Union Depot) 150 Thomson '93 arc lights.

The Sioux City Engine & Iron Works have closed contracts for complete power plants for electric light stations in the last 30 days at the following places: Estherville, Iowa, Yankton, S. D., Plymouth, Iowa, Clear Lake, Iowa, Albert Lea, Minn., Hampton, Iowa, Bethany, Mo., Osceola, Iowa, and Eagle Grove, Iowa. A 500 horse power plant has been ordered for the Leavenworth Street Railway company, Leavenworth, Kansas, besides several plants for other purposes than electric light.

Arrangements have been perfected by which the manufacture of the Waddell-Entz dynamos and motors will be carried on with improved manufacturing facilities and on a more extensive scale than formerly. The machines will be built in Bridgeport, Conn., in a new shop fully equipped with the most improved tools and machinery, overhead traveling crane, etc., and ample facilities for turning out the highest class of mechanical work with promptness and dispatch. Mr. Waddell still retains his connection with the enterprise, and the sales department will be in charge of J. A. Machado, who has been connected with the Waddell-Entz company since its organization. Correspondence and inquiries should be addressed to J. A. Machado, agent, 203 Broadway, Mail and Express building, New York.

The Dayton Globe Iron Works company, successor to Stout, Mills & Temple of Dayton, O., has for some time

been making and testing at the Holyoke testing flumes, Holyoke, Mass., a new line of its new American turbine water wheels, greatly increasing the capacity of each diameter. Recent tests of a 45-inch and 42-inch wheel reached a higher average efficiency from whole to half water, it is said, than had been previously achieved. These tests place the new American in the van in turbine manufacture. High efficiency at whole water and low efficiency at part water does not constitute a first class turbine, as it is impractical to properly operate any kind of machinery without reserve power. A margin must be left for emergencies and for fluctuation of head. The construction of the new American is such that the highest efficiency is obtained at seven-eighths to three-fourths water, as seen by the following, copied from the official report of the test of a 45-inch new American turbine, tested on July 9, 1894: Whole gate (meaning whole water), 79.76 per cent.; seven-eighths gate, 82.58 per cent.; three-fourths gate, 82.18 per cent.; five-eighths gate, 79.31 per cent., and one-half gate, 75.52 per cent; average efficiency from whole to half-water, 79.87 per cent.

The Mather Electric company of Manchester, Conn., reports a marked increase in orders since the passage of the new tariff bill was assured. The sales for lighting apparatus since then are as follows: New Davidson Theater, Milwaukee, 2,000 lights; A. W. Perry, Boston, Mass. (fifth order), 350 lights; Hotel Minot, New York city, 650 lights; Hoboken Quartet Club, Hoboken, N. J., 150 lights; Henry Remhardt, New York city, 250 lights; E. P. Gleason Manufacturing company, New York city, 250 lights; Piscataquis Woolen company, Guilford, Me., 600 lights; Danvers Insane Asylum, Danvers, Mass., 250 lights; Newport Gas Light company, Newport, R. I., 250 lights; State Almshouse, Tewksbury, Mass., 600 lights; Whittenton Manufacturing company, Taunton, Mass., 150 lights; Weise Bros., Moline, Ill., 250 lights; Chambers Electric Light & Power company, Truro, N. S., 500 lights; Union Central Life Insurance Building, Buffalo (third order), 250 lights; Beck Brewing company, Buffalo, N. Y., 600 lights; Comstock Construction company, Chicago, Ill., 250 lights; Gallagher Bros, Meridian, Miss. (third order), 100 lights; New Ford's Opera House, Washington, D. C., 450 lights; Jones Bros. Electric company, Cincinnati, O. (seventh order), one 50 horse power 220 volt generator; New Pittsburg Coal company, New Pittsburg, O., one 60 kilowatt 220 volt generator; Morris Coal company, Sand Run, O., one 60 kilowatt 220 volt generator; Harry S. Smith & Co., Philadelphia, Pa., two 45 kilowatt direct connected generators. The company also announces a large sale of the new Manchester type slow speed stationary motors in sizes from 3 to 50 horse power.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued August 28, 1894.*

525,001. Insulator. Leonard W. Bradley, Cleveland, O. Application filed February 13, 1894.

The special feature of the device is the method employed in stringing electric wires, whereby the wrapping of the wire around the insulator and tying thereto are avoided, and an insulator secured which is simple in construction and easily applied in use, and which has a neat appearance.

525,007. Manufacture of Carbon Filaments. Thomas A. Edison, Llewellyn Park, N. J. Application filed December 15, 1886.

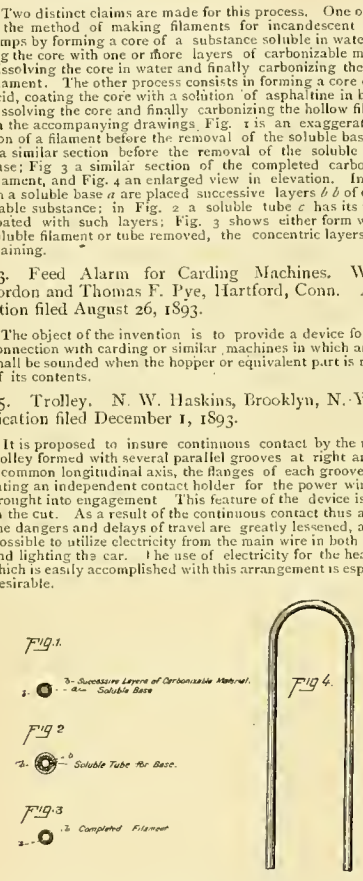
Two distinct claims are made for this process. One of these is the method of making filaments for incandescent electric lamps by forming a core of a substance soluble in water, coating the core with one or more layers of carbonizable material, dissolving the core in water and finally carbonizing the hollow filament. The other process consists in forming a core of boric acid, coating the core with a solution of asphaltine in benzole, dissolving the core and finally carbonizing the hollow filament. In the accompanying drawings, Fig. 1 is an exaggerated section of a filament before the removal of the soluble base; Fig. 2 a similar section before the removal of the soluble tubular base; Fig 3 a similar section of the completed carbonizable filament, and Fig. 4 an enlarged view in elevation. In Fig 1 on a soluble base *a* are placed successive layers *b b* of carbonizable substance; in Fig. 2 a soluble tube *c* has its interior coated with such layers; Fig. 3 shows either form with the soluble filament or tube removed, the concentric layers *b b* remaining.

525,013. Feed Alarm for Carding Machines. W. W. Gordon and Thomas F. Pye, Hartford, Conn. Application filed August 26, 1893.

The object of the invention is to provide a device for use in connection with carding or similar machines in which an alarm shall be sounded when the hopper or equivalent part is relieved of its contents.

525,015. Trolley. N. W. Haskins, Brooklyn, N. Y. Application filed December 1, 1893.

It is proposed to insure continuous contact by the use of a trolley formed with several parallel grooves at right angles to a common longitudinal axis, the flanges of each groove constituting an independent contact holder for the power wire when brought into engagement. This feature of the device is shown in the cut. As a result of the continuous contact thus attained the dangers and delays of travel are greatly lessened, and it is possible to utilize electricity from the main wire in both heating and lighting the car. The use of electricity for the headlight, which is easily accomplished with this arrangement is especially, desirable.




NO. 525,007.

525,016. Trolley Wire Switch and Crossing. N. W. Haskins, Brooklyn, N. Y. Application filed April 23, 1894.

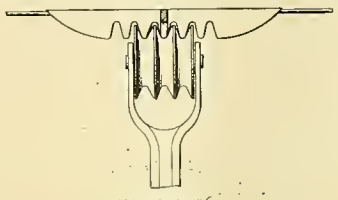
The cut shows how electrical connections are made where conductors cross each other or join each other at curves, etc, and is designed to provide for the free passage of the grooved trolley described in the preceding patent, No. 525,015, without danger of its over-riding or being displaced from its conducting wire while crossing another line or rounding a curve. The invention consists essentially in forming the flanges upon the corner or cross plates with notches which coincide in position with the several flanges upon a trolley with the several bearing surfaces, so that the trolley will pass over a cross conductor, or over a branch of the same conductor, without touching either, its contact with its own conductor being thus preserved and maintained, and the dangers and delays of broken contact avoided.

525,017. Storage Battery. Henry K. Hess, Syracuse, N. Y. Application filed October 11, 1892.

In this battery the active faces of the electrodes are separated by an electrolyte conductor of great porosity and high non-electric conductivity, which is indestructible by the acid of the electrolyte. It consists essentially in a suitable casing or shell containing an electrolyte, electrodes connected by the electrolyte and a layer of quartz sand between the active faces of the electrodes having the separate grains or particles held together by non-electric conducting adhesive material.

525,018. Storage Battery. Henry K. Hess, Syracuse, N. Y. Application filed February 13, 1893.

The special feature of this battery is the method of construction by which the active material is supplied with an abundance of the electrolyte, and is firmly and positively held in position without the agency of confining plates or the necessity of mechanically applying the active material to the electric conductor by pressing the active material into apertures or cut-outs formed in the electric conductor. It consists essentially in an electrolyte-containing cell and electrodes arranged within the cell and insulated one from the other and composed of cores of active material, and electric conductors incasing the active material and having their central portions formed with a series of perforations, and their inner surfaces electrically connected to the cores of active material, and non-electric conducting material arranged within the perforations of the electrodes for supporting the active material and conducting the electrolyte thereto.



NO. 525,016.

525,020. Electrical Fire Alarm Apparatus. E. W. Junger, Stockholm, Sweden. Application filed November 8, 1893.

This device relates to electric fire alarms, and more especially to that class in which the alarm is given or the location of the fire otherwise indicated by the influence of a thermo-electric current.

525,034. Electric Arc Lamp. Elihu Thomson, Lynn, Mass. Application filed January 24, 1894.

The special feature of this lamp is the simple feeding mechanism, working positively and yet with delicacy. A derived circuit coil or magnet acting against a retractor is employed, such as a weight or spring, and a feeding circuit comparatively independent in its feeding action, but dependent for the times of action on the first magnet.

525,035. Electric Arc Lamp. Elihu Thomson, Swampscott, Mass. Application filed May 16, 1894.

By improved construction a simple arc lamp is secured, which, when desired, can be adjusted so that at a certain strength of current its action shall be like that of a differential lamp, where one magnet in the direct circuit acts differentially or pulls against another magnet in the derived circuit around the lamp, although the action is not differential, but reproduces the effects of differential lamps. With a little higher strength of current the lamp regulates its arc entirely by the action of the shunt or derived circuit magnet; this variation may be accomplished for the normal current by a simple change in the effect of the main circuit winding, as by shunting it or varying its turns.

525,037. Means for Limiting Tension of Driving Springs. Paul Wendelboe, New York, N. Y. Application filed February 27, 1894.

The objects of this invention, which relates more particularly to that class of machines known as printing telegraph or ticker instruments, though it is equally applicable to all clock-work instruments which are driven by springs automatically wound from time to time, are to prevent the over-winding of the drive-springs of such instruments while keeping them sufficiently wound to do the work required of them in an efficient manner.

525,082. Train Robber Alarm. Max Z. Levy, Kansas City, Mo. Application filed March 27, 1894.

Devices for notifying the express messenger, the passengers, and the train men not occupying the cab of the engine and the tender of the train, of the presence of train robbers, are comprised in this arrangement.

525,108. Electric Motor. A. V. Meserole, New York, N. Y. Application filed January 8, 1894.

The invention relates to electrical'y controlled, variable speed and reversible motors, and consists in features of construction and novel combinations of parts.

525,134. Circuit Breaker. C. C. Chesney, Pittsfield, Mass. Application filed July 6, 1894.

The improvement comprises the combination with the terminals of a break in a circuit and a swinging or pivoted bridge-piece for connecting it to complete the circuit of a weight or weighted lever engaging with the bridge-piece, but capable of a certain free or lost motion relatively to the same, whereby it may, when released for the purpose of interrupting the circuit, fall by gravity and acquire a sufficient momentum to instantly and positively separate the bridge-piece from the terminals at the moment of engagement with the bridge-piece. It also includes the combination with the swinging bridge-piece or circuit-breaking lever and the weighted lever already described of carbon points or pencils arranged to form a high resistance path for the circuit for a short interval after the separation of the main contact points, and thus avoid sparking.

525,145. Electro-magnetic Call Bell. John J. Geary, Chester, Pa. Application filed January 26, 1894.

Improvements in the general construction and arrangement of these devices are covered in this patent.

525,169. Electric Bell. Richard Varley, Jr., Engelwood, N. J. Application filed September 21, 1893.

The main features of this device are the combination with the electro-magnet and its armature of a screw forming one electrode, a bracket through which the screw passes and insulating material between the screw and the bracket, a U-shaped clip piece through which the screw passes, elastic material between the nut portions of the clip and the bracket, and insulating material between the end of the bracket and the clip piece.

525,201. Telephone Transmitter. John Goodman and Henry Goodman, Louisville, Ky. Application filed May 1, 1894.

In this class of telephone transmitters the opposite poles of two magnets are approximated, with intervening magnetic particles, one of the magnets being mechanically related or connected to a vibratory diaphragm. The improvement consists in arranging the movable magnet of the pair in such a manner as to receive the impulses propagated from the diaphragm on the principle of a lever, these impulses being thereby increased or diminished according to the point at which the mechanical connection is made. When the movements of the magnet are amplified, the sounds heard in the receiver are increased in volume; when diminished, they are more sharp and accentuated.

525,235. Dry Battery. J. I. Solomon, New York, N. Y. Application filed April 11, 1894.

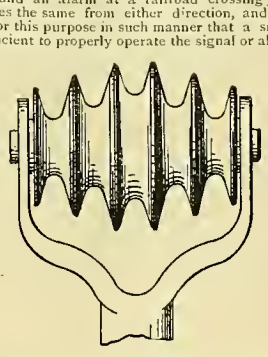
A jar of glass or equivalent material, a curved plate of zinc, a carbon rod, a mixture of granulated black oxide of manganese and granulated carbon cemented together by chloride of zinc and surrounding the rod, a bag of textile material surrounding the carbon-manganese mixture, a filling of sawdust saturated with a solution of sal-ammoniac, a seal filling the upper portion of the jar and surrounding the carbon and wire leading from the zinc, and a vent tube extending from the sawdust filling through the seal form the component parts of this invention.

525,266. Circuit-closing Device. John J. Geary, Chester, Pa. Application filed February 5, 1894.

This invention provides a simple, durable, inexpensive and effective circuit-closing device for application to floors for establishing a circuit to cause an audible sound or signal of a buzzer, bell or annunciator, or in application to doors or windows for similar purposes.

525,290. Electrical Railroad Signal. William F. Seymour, Mansfield, O. Application filed June 30, 1894.

The special application of this system is in connection with crossings at a country road, or where two railroads cross, the object being to produce simple and efficient means to automatically sound an alarm at a railroad crossing when a train approaches the same from either direction, and to construct devices for this purpose in such manner that a small battery will be sufficient to properly operate the signal or alarm.



NO. 525,015.

525,291. Electric Alarm Lock. John Slater, Hutchins, Pa. Application filed November 9, 1893.

The object of this invention is to provide a lock or latch of such construction that when the spindle is not properly manipulated to engage the latch-bolt for the purpose of retracting it an electric circuit is made or broken and sounds an alarm.

525,293. Incandescent Electric Lamp Cut-out. Walter F. Smith, Philadelphia, Pa. Application filed August 23, 1889.

This invention consists in shunting the electric current traversing the dynamo or generator circuit in which the lamp is included, and causing one portion of the current to pass through the filament of the lamp, and the other through the shunt circuit, and with a substance or material of high electrical resistance readily melting or softening interposed in said shunt circuit, with a pin in contact and an actuated lever, whereby the lamp is short-circuited by the melting or softening of the substance or material.

525,312. Method of and Apparatus for Changing Period and Phase of Alternating Currents. Charles S. Bradley, Avon, N. Y. Application filed July 10, 1893.

This is accomplished by operating by a single-phase alternating current a synchronous motor by which is rotated in a magnetic field at a fractional or multiple speed one or more electric circuits in which the current or currents of different time periods are to be generated.

525,315. Rosette for Electric Light Wires. D. J. Cartwright, Boston, Mass. Application filed January 16, 1894.

This improvement facilitates the application of the lamp-cord to the rosette, as well as enables the knotting together of the strands of the lamp-cord to be effected before it is applied to the rosette, and also to improve the interior construction of the bulb or boss.

Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, SEPTEMBER 15, 1894. No. 11

## Hermann von Helmholtz.

By the death of Professor von Helmholtz in Berlin on September 8th the world loses a man who had fairly earned a reputation in the domain of science second to that of none of his contemporaries. The range of his knowledge and investigations was astonishing. In mathematics, in physics, in anatomy, in electricity, in optics, in acoustics, in physiology, in therapeutics, in the theory of music, in the phenomena of heat—in all of these sciences his utterances were universally held to be of the highest authority, not only in Germany, but in England, France and America as well—wherever scientists are found and scientific knowledge is respected. Prof. Elihu Thomson, in introducing von Helmholtz to the World's Congress of Electricians a year ago, spoke of him as "the type of the man of general science," and he did stand for that type, more fully, perhaps, than any other *savant* of his time. Not only that, but his researches were of great practical value to the human race, as is shown by his ophthalmoscope, an instrument which renders possible the inspection of the retina of the living eye, and which revolutionized the treatment of diseases of the eye. Von Helmholtz also did much to popularize science by lectures and popular treatises. He desired the masses of humanity to reap the fruit of his labors, both in knowledge and in applied results. In this work he co-operated for many years with the late John Tyndall, and both men were eminently successful in this endeavor.

Hermann Ludwig Ferdinand von Helmholtz was born in Potsdam, Prussia, on August 31, 1821. His father was an instructor in the local gymnasium, and his mother, whose maiden name was Caroline Penn, came from a branch of the family which produced William Penn. The son evinced a taste for science from infancy, and he began a preparation for the medical profession as soon as he was old enough to study. At the age of seventeen he went to Berlin and entered upon the study of medicine at the Royal Military School. After receiving the degree of doctor of medicine, he became a surgeon at the Charity Hospital of Berlin, and afterward a military surgeon at Potsdam. Here in 1847 he wrote and published his first book, a scholarly treatise on "The Conservation of Force." The appearance of this volume attracted much attention, and the young physician was at once regarded as a rising man in his profession, who was probably destined to fill a considerable place in the world of science. The next year he became assistant professor in the Anatomical Museum of Berlin, which was then under the direction of the famous anatomist, John Müller. This association was of great advantage to Helmholtz, and he made such advancement that in the following year he was called to succeed Ernst Bruckes in the chair of physiology at the University of Konigsberg. He was transferred to a similar place at Bonn in 1855, and at Heidelberg in 1865, and in 1871 to the place formerly occupied by Magnus as professor of physical science at the University of Berlin.

His chief achievements in science, and especially in optics, acoustics, physiology and therapeutics, date from his accession to the chair of physiology at Konigsberg. His first great discovery, for the benefit of innumerable sufferers from diseases of the eye, was made in 1851. Reflecting one day upon the circumstance that, while it is impossible in daylight to see clearly into a room on the opposite side of the street, it is easy to do so at night when the room is artificially illuminated, and also in daytime, by reflecting into the room strong rays of light from a mirror, he was led to the invention of an eye-mirror, or ophthalmoscope, by which the interior of the eye is readily examined. He described this invaluable device in a volume published in the same year. The results of his further investigations of the eye appeared in a work entitled "Manual of Physiological Optics," which was published in 1856 and has ever since ranked as one of the most important works extant on that subject. In this treatise Helmholtz gives not only the results of his own investigations, important as they are, but also one of the most complete histories of optics ever written. He also discusses the doctrine of sight perception and the analysis and appreciation of colors. This was followed by him with a second volume on the transmission of nervous impressions, a highly valuable addition to the literature of physiological science.

The University of Bonn was the scene of Helmholtz's chief investigations in acoustic physiology, in which he laid the foundations of the work which made his name famous. He here invented a method of analyzing sound by the use of hollow bodies, called resonators, in which the air vibrates in the presence of previously determined sounds. He thus discovered that the difference of quality in the tones of different musical instruments resides in the different compositions of the tones. He also discovered the acoustic origin of the vowel sounds of human speech, and not only analyzed them, but also produced them artifically with tuning forks. He demonstrated that there are but few primary sounds, as there are few primary colors, and that as the colors of most objects in nature and art are formed by combinations and modifications of the primary hues, so most sounds are complex in character. He showed that the painful effect upon the eye caused by a faint or unsteady light is identical in nature with the unpleasant impression produced upon the ear by a succession of shocks of sound. Indeed, it was he who first established a relationship and correspondence between sound and light by demonstrating the existence of a series of "sound colors" arranged in accordance with the laws of the solar spectrum. To him also are to be attributed the invention of the ophthalmometer, which measures accurately the images on the retina of the eye; the table of compound colors, produced by mixing other colors, and much of our knowledge of atmospheric vibration, of the movement of electricity in various conductors and of the motion of light and its refraction in different mediums.

HERMANN VON HELMHOLTZ.

It would be difficult indeed to give an exact and complete account of Von Helmholtz's contributions to science. His work in electricity has been overshadowed by other of his great achievements, but electrical engineers recognize the great value of his researches, extended over many years, in the study of electrical science and of the laws on which that science depends. His eminence as an electrical scientist was very fittingly recognized by the German government, which named him as the first of the official delegates from his native country to the World's Electrical Congress that assembled in Chicago on August 21, 1893. Prof. von Helmholtz was received in America with the greatest enthusiasm. The congress honored itself and honored the great German scientist by choosing him as its honorary president, and when he was escorted to the presiding officer's desk the members of the congress rose to their feet and cheered again and again. He made a little speech in English, reported in the WESTERN ELECTRICIAN of August 26, 1893. The following extract will serve to show his abiding interest in electricity and will be read with especial interest at this time:

> I think I am the most aged of the electricians who are present here. The beginning of my career was at a time when the phenomena of electricity were apparent only by the most delicate experiments in the laboratory. Where we to-day move great machines of the mightiest power, in that old time when I began to study electricity we could only move little magnetic needles suspended on the finest silken thread that we could obtain. We balanced two such needles on the opposite poles in order to get any token of an electric current, or even the most delicate index of electrical current, such as was obtained by Volta from the frog. He could do nothing but make an oscillation or contraction. He could not move the slightest apparatus, but he saw that there were visible currents. At that time we had no constant electromotive force. We were obliged to work with simple battery elements of copper and zinc, without sulphate of copper, and elements which altered with every movement; which had in the first instance a great electromotive force and then went down, down, down, so that in some instances there was scarcely any force at all, or only traces of the former force. Now all that is changed. In the beginning of my career, we knew nothing of the great discoveries of Faraday of induced currents, which have developed now into currents that can drive the mightiest machines.

Prof. von Helmholtz was the recipient of many honors. As early as 1870 the French Academy elected him to its foreign membership. There was some slight objection to him on account of his nationality, but it soon disappeared before the words of one of the most eminent members, who said: "You will place yourself in a bad light before the world if for any reason you refuse to admit Helmholtz, the foremost and greatest naturalist of the present age." Again, in 1873, Sir George Airy, in awarding to Helmholtz the Copley medal, and speaking officially as president of the Royal Society, said: "It would be difficult for me, within the limits of this address, to state the number and importance of the claims of Prof. Helmholtz to our recognition." The German emperor in 1883 issued a decree raising him to the rank of nobility, and from other countries and from numerous learned bodies and institutions he has received tokens of highest honor. In 1891 von Helmholtz's seven-

tieth birthday was honored by a great demonstration in Berlin, and every means was taken to show the great esteem in which the scientist was held. Addresses, honorary titles and presents were showered upon him in profusion, and from all parts of Europe and America. A feature of the celebration was the creation of a fund for the purpose of bestowing Helmholtz medals on scholars distinguishing themselves in scientific fields of research. In the same year von Helmholtz was made president and director of the Imperial Technical Institute of Physics at Charlottenberg, a foundation under the control of the Department of the Interior for the experimental furthering of exact natural inquiry and the technics of precision. This position he held at the time of his death, which was due to a stroke of paralysis.

Among the scientific works of von Helmholtz was a paper on "Force Required for the Production of Electric Currents" (1851) and another "On the Formation of Electric Currents in Living Bodies" (1853).

Von Helmholtz devoted his entire life to science. He was wrapped up in his work, but not egotistical. He was careful to do justice to others, and he several times published notes to show that his own results were not so new as he and the scientific world believed them to be. He did much to bring into notice the works of other physicists, notably the Americans, Rowland and Root. In his lectures he was not an orator. He spoke slowly and deliberately and in a calm voice. His language was simple and free from long and involved phrases. The exposition of his subject was clear and forcible; he taught the students how to think for themselves and how to work.

Prof. von Helmholtz had a fine face and and a well-built figure. The portrait on the preceding page is a reproduction of the famous painting by Knaus, executed in 1881, and now hanging in the Royal National Gallery of Berlin.

## Wisconsin Electric Club.

The board of directors of the Wisconsin Electric club, Milwaukee, announces an important change in the club room arrangements for the coming season. The Wisconsin Electric club, jointly with the Polytechnic and Milwaukee Architects' societies, has taken a suite of rooms on the second floor of the building now being erected by the Milwaukee Brewing association at No. 183 Third street—"The Studio." The rooms will be held exclusively for the use of the members of the three societies named, and will be furnished in the old "German" style. All conveniences of the restaurant will be provided for by a chute from the restaurant below. The lounging and sitting rooms will be used by the three clubs jointly, the lecture room being reserved one night a week for each club.

By this arrangement a large saving in the club's expenses will be made, and it is possible that the dues for the year commencing November 1st may be reduced—a question that will be acted upon at the first regular meeting, which will take place at the new location in the early part of October.

## Duncan Meter for Alternating Currents.

By Wm. S. Resor, B. S.

One of the problems which has confronted electrical engineers has been the invention of a commercial alternating current recording meter which will record all loads correctly.

The credit of having solved this problem must be given to Thomas Duncan of the Fort Wayne Electric corporation, Fort Wayne, Ind.

In the early days of electric lighting it was customary to charge so much per lamp per week, month or year, because there were no practical recording meters.

This was, of course, most unsatisfactory both to supply companies and to consumers. A recording meter was the dream of both. Before long, various types of recording meters appeared, which recorded, it is true, but gave no satisfaction, for the greater part of them made electric light very cheap for the small consumers and very expensive for the large, on account of the slow speed on a small number of lights and the high speed on a large number. But each has in turn been succeeded by others claimed to be better, and now the Duncan meter seems to have reached the end of the line, and combines the virtues of all, and, let us hope, the defects of none.

This meter is dependent on the principle of the repulsion of a closed secondary from its primary, and is a thoroughly practical and efficient development of Prof. Elihu Thomson's classical experiments on that principle.

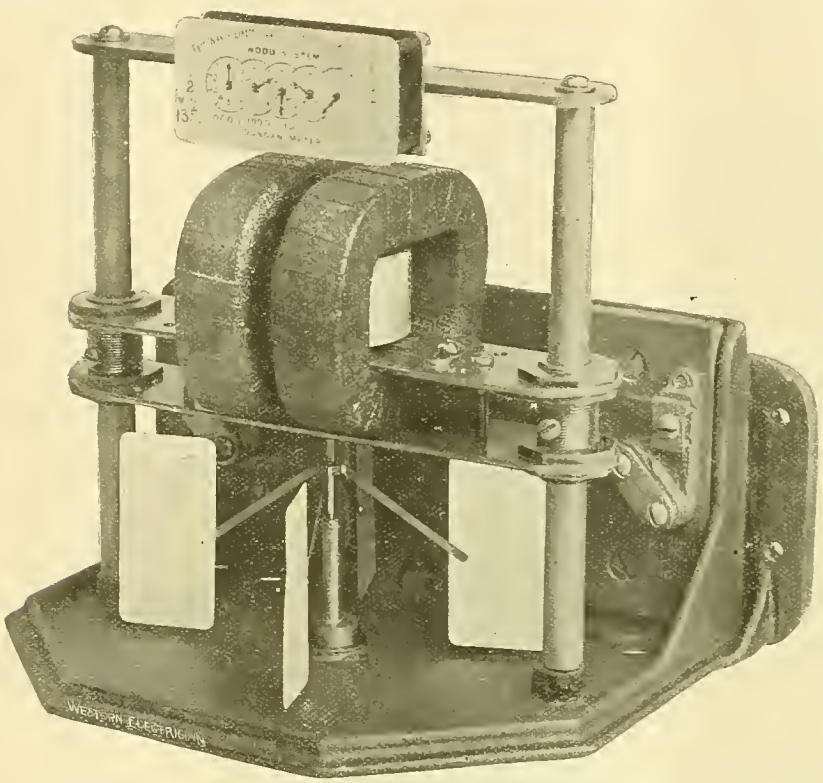


FIG. 1. DUNCAN METER FOR ALTERNATING CURRENTS.

The essential parts of the meter are the primary or field coils *A A'* (see Fig. 2), which are connected in series with the lamp circuit, the secondary or armature *C* consisting of an aluminum cylinder, a magnetic path diverter *d*, made of laminated iron, and carrying a closed secondary *S*, which consists of several copper punchings, the aluminum fans, the registering train, and the spindle which carries the armature and fans.

This meter is the only one upon the market whose speed curve is a straight line. The following table contains the results of a test on a twelve-light Duncan meter:

| No. of Lamps. | Revs. Min. | Initial Speed. | Per cent. Error. |
|---|---|---|---|
| 1 | 14 | 14 | —6.6 |
| 2 | 30 | 15 | 0 |
| 3 | 45 | 15 | 0 |
| 4 | 60 | 15 | 0 |
| 5 | 75 | 15 | 0 |
| 6 | 90 | 15 | 0 |
| 7 | 105 | 15 | 0 |
| 8 | 120 | 15 | 0 |
| 9 | 135 | 15 | 0 |
| 10 | 150 | 15 | 0 |
| 11 | 165 | 15 | 0 |
| 12 | 180 | 15 | 0 |
| 13 | 195 | 15 | 0 |
| 14 | 210 | 15 | 0 |
| 15 | 225 | 15 | 0 |

The speed on one light is a few per cent. slow, on some as low as 2 per cent., but on all other loads the meter is correct. Fig. 4 shows the speed curve plotted from the foregoing table. Fig. 5 shows the speed curve for a twenty-five-light meter and is plotted from the following table:

| No. of Lamps. | Revs. Min. | Initial Speed. | Per cent. Error. |
|---|---|---|---|
| 1 | 9 | 9 | —10 |
| 2 | 20 | 10 | 0 |
| 3 | 30 | 10 | 0 |
| 4 | 40 | 10 | 0 |
| 5 | 50 | 10 | 0 |
| 6 | 60 | 10 | 0 |
| 7 | 70 | 10 | 0 |
| 8 | 80 | 10 | 0 |
| 9 | 90 | 10 | 0 |
| 10 | 100 | 10 | 0 |
| 11 | 110 | 10 | 0 |
| 12 | 120 | 10 | 0 |
| 13 | 130 | 10 | 0 |
| 14 | 140 | 10 | 0 |
| 15 | 150 | 10 | 0 |
| 16 | 160 | 10 | 0 |
| 17 | 170 | 10 | 0 |
| 18 | 180 | 10 | 0 |
| 19 | 190 | 10 | 0 |
| 20 | 200 | 10 | 0 |
| 21 | 210 | 10 | 0 |
| 22 | 220 | 10 | 0 |
| 23 | 230 | 10 | 0 |
| 24 | 240 | 10 | 0 |
| 25 | 250 | 10 | 0 |

Fig. 6 is the curve for a fifty-light meter, plotted from the data of the following test:

| No. of Lamps. | Revs. Min. | Initial Speed. | Per cent. Error. |
|---|---|---|---|
| 1 | 4¼ | 4¼ | —15 |
| 2 | 10 | 5 | 0 |
| 4 | 20 | 5 | 0 |
| 6 | 30 | 5 | 0 |
| 8 | 40 | 5 | 0 |
| 10 | 50 | 5 | 0 |
| 12 | 60 | 5 | 0 |
| 14 | 70 | 5 | 0 |
| 16 | 80 | 5 | 0 |
| 18 | 90 | 5 | 0 |
| 20 | 100 | 5 | 0 |
| 22 | 110 | 5 | 0 |
| 24 | 120 | 5 | 0 |
| 26 | 130 | 5 | 0 |
| 28 | 140 | 5 | 0 |
| 30 | 150 | 5 | 0 |
| 32 | 160 | 5 | 0 |
| 34 | 170 | 5 | 0 |
| 36 | 180 | 5 | 0 |
| 38 | 100 | 5 | 0 |
| 40 | 200 | 5 | 0 |
| 42 | 210 | 5 | 0 |
| 44 | 220 | 5 | 0 |
| 46 | 230 | 5 | 0 |
| 48 | 240 | 5 | 0 |
| 50 | 250 | 5 | 0 |

Fig. 7 is an initial speed curve for a twenty-five light meter and shows the remarkable constancy which the meter maintains throughout its entire range.

Mr. Duncan has also applied this principle to meters for measuring and recording multiphase currents, and with particular success in the cases of two and three-phase currents, also as a wattmeter for measuring the total energy. Fig. 8 shows a two-phase meter and Fig. 9 a three-phase.

A striking peculiarity of the multiphase current meter is that it can be operated with single phase currents, by simply connecting its field coils in series or multiple arc and in series with the lamps. Fig. 1 shows a complete meter.

A very important feature of this meter is that there are no brushes or commutator to get out of order, or other contacts to become dirty and oxidized. The armature has no electrical connection with the circuit.

The motion of the armature or cylinder is due to the repulsion set up against it as a closed secondary, from the primary or field coils *A* and *A'*.

The action is explained more fully as follows: When the lamps are turned on the current flows through the coils *A* and *A'*, and an alternating field is set up. This field is distorted or diverted from its natural direction, along the axis of *A* and *A'*, by the diverted *d*, and assumes a form similar to that shown in Fig. 3. Foucault currents are generated in the armature and also in the closed secondary on the diverter. The use of this secondary on the diverter is to reverse its polarity.

Suppose we consider the instant when the polarity of the primary or field coils *A* and *A'* are as shown in Fig 3. The flux as it cuts through the cylinder obliquely, as is shown by the dotted line, will develop Fancault currents in it, which will have poles as shown in the diagram; that is, a south pole on the outside circumference of the cylinder and facing the south pole *S* of the primary coil *A*, thereby setting up a repulsion, due to their being of the same polarity. Again, the north pole *n*, which is shown on the inner circumference of the cylinder, will be attracted by the south pole *s* of the diverter *d*. Therefore the rotation is due to the repulsion set up by the two south poles on the outside of the cylinder, and the attraction between the two unlike poles inside. The same condition exists on the other or

right-hand side of the cylinder, only differing in the change of polarity.

The closed secondary, which is divided into two, each half being placed upon the respective poles of the diverter *d*, is for the purpose of changing the original or induced polarity of the diverter, so as to obtain a maximum torque in effecting an attraction between the induced poles on the inner surface of the cylinder and the diverter.

If the axis of the diverter be placed along the axis of the coils *A* and *A'*, or at right angles to it, there will be no motion, all the energy being expended in producing a lateral pressure on the shaft, but as soon as we move it from either of these positions, the force acts along a line which does not pass through the vertical axis, hence we have motion, whose speed depends on the size of the angle formed by the two axes. Forty-five degrees gives the greatest speed.

## Notes on Recording Meters.

By Eustace Oxley.

There is nothing of greater importance to electric companies doing business on a meter basis than that their meters record correctly; and that they may do so, care must be taken to install them under proper conditions. Especially is this the case with motor meters; and as my experience has been largely with meters of that kind, and particularly with the Thomson recording wattmeter, I will refer only to that type. To install the meter in a suitable location (that is, a clean, easily accessible place, free from moisture, vibration and liability to mechanical injury) is of the first importance. The meter should be inspected, within a day or two after having been installed, to make sure that it is running properly, and that all connections are tight. It is advisable to have the meter placed where it can be readily got at, so as to facilitate reading and inspection. Should the meter be installed in a damp place, the commutator quickly becomes tarnished, rust attacking parts of the recording gear and accumulating on the permanent magnets, sometimes to such an extent as to choke up the space between the magnet poles and the revolving disk, thereby stopping the meter. I have frequently seen this occur, and as the effect is gradual, it is not likely to be noticed, unless regular inspection be made, until after many weeks, in some cases months, during which time the company would be steadily losing income. When dirt gets into the meter, as it will in some places, unless extra precaution be taken, it is liable to cause friction in the recording mechanism, and, by

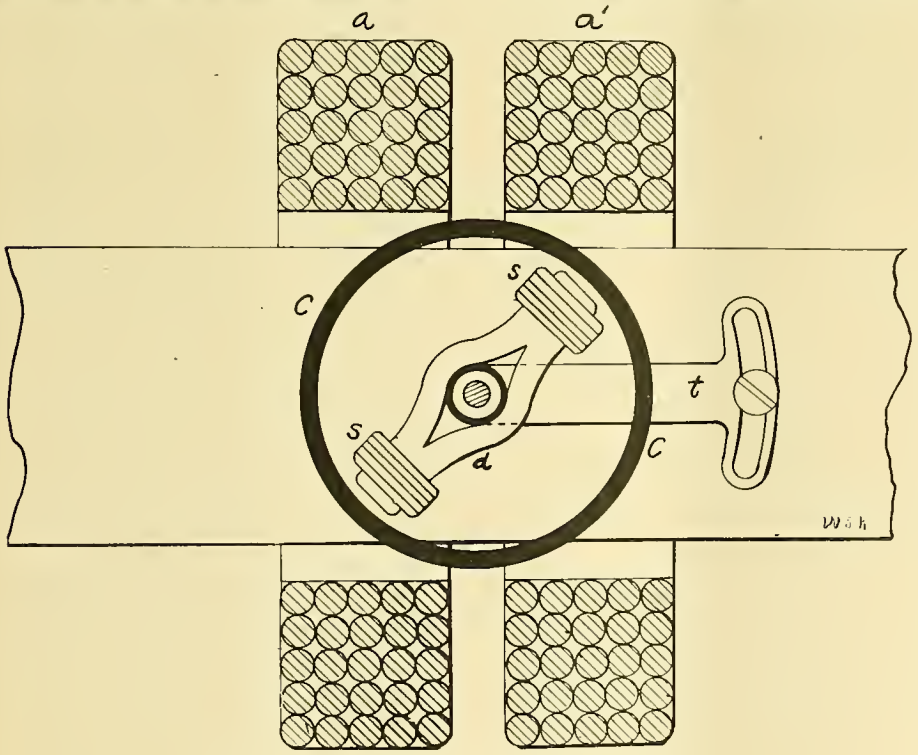



FIG. 2. DUNCAN METER FOR ALTERNATING CURRENTS.

collecting on the armature and copper disk, put a load on the meter, causing it to run slow. Care should therefore be taken to fill all spaces round the wires where they enter the meter. This precaution is very necessary when the meter is situated in places where insects abound; in fact it would be better if in such places a "tropical meter" were installed. I have seen a fully loaded meter stopped by cockroaches collecting on the disk and armature. This meter was removed and another substituted, which was provided with rubber diaphragms over the holes where the wires entered, and extra care was taken to fill all crevices where it was thought the insects could enter, but in spite of these precautions it was found after a month's time to have stopped from the same cause. Vibration is liable to fracture the jewel and weaken the permanent magnets; meters should not therefore be placed near elevator shafts, nor in places where they are liable to be affected from this cause. Rough handling, either before or when the meter is installed, is frequently the cause of its not recording correctly; hence the advisability of frequent inspections. If the conditions mentioned are not complied with, trouble will develop sooner or later, causing the meter in almost every case to run slow—hence to the company's loss. When this meter is installed with ordinary care, it will always prove an instrument whose accuracy and sensitiveness remain unchanged.

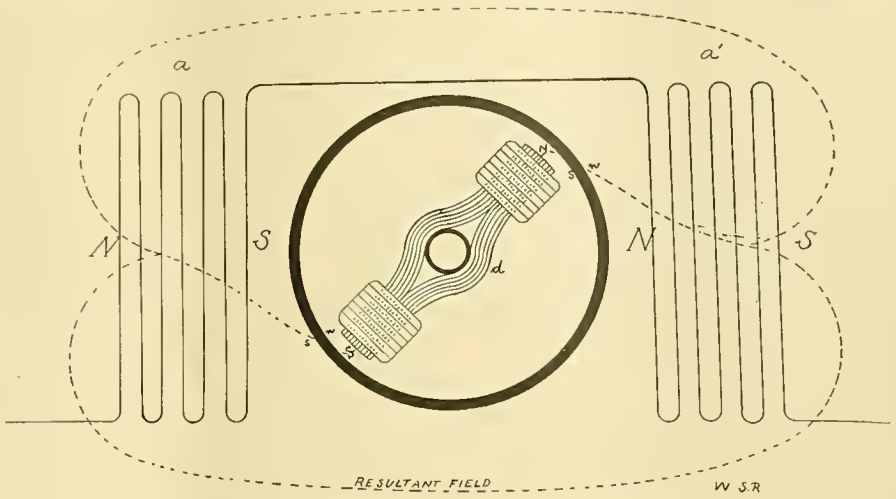



FIG. 3. DUNCAN METER FOR ALTERNATING CURRENTS.

## Chicago Edison Changes.

The large new station of the Chicago Edison company at Harrison street and the river, West Side, is now carrying the entire down-town incandescent load of that company. The big plant was put in operation on August 1st and was run in multiple with the old Adams street station until August 19th, when the latter was shut down, the fires drawn and the plant definitely put out of service. The Harrison street station is almost finished, but still lacks a few details of equipment, which will be supplied within a month. Its smoothness and economy of operation thus far have been very satisfactory. On the dark afternoon of September 6th the new plant carried 19,000 amperes without mishap of any kind, and the officers of the company apprehend no difficulty with the heavy fall and winter load.

A considerable proportion of the old Adams street equipment has been already sold. Five single-cylinder Armington & Sims engines—three of 500 horse power each and two of 250 horse power—with four 150 kilowatt bipolar Edison dynamos and the necessary belting have been purchased by the Cincinnati Edison Electric company. The General Electric company has taken four 150 kilowatt dynamos and two of 100 kilowatts. An entire electrical outfit for light and power has also been sold from this stock to Norton Bros., car manufacturers, of Maywood, Ill. This consists of two 100 kilowatt dynamos and two 30 kilowatt machines, with 64 low-tension arc lamps, wiring for 694 incandescent lamps and all necessary switchboard apparatus. This plant will replace one that has been long in use and will supply current for 40 horse power in motors as well as light.

## A Telephone Nuisance Corrected.

"A business friend of mine has finally succeeded in ridding himself of a great nuisance," said Ernest F. Edwards of Boston to a *St. Louis Globe-Democrat* reporter. "His office happens to be on a floor in a building where there are a large number of tenants, but no other telephone besides his own. The result is, he has for months been bored to death by telephone deadbeats, many of whom have used his telephone a great deal more than he has. The nuisance got so bad at last that it was quite usual to have two visitors waiting for each other at the 'phone. He tried various devices for a long time, but finally took the company into his confidence and got them to give him a new number, but not to change the plate on the 'phone. He specially notified "Central" on no account to connect any one who called up the old number. The scheme worked like a charm. For a day or two the nuisance was increased by the importunities of patrons of his telephone and their indignant protests when they failed to secure connection. It did not take long, however, for them to realize that the telephone was of no further use to them, and the way my friend echoed their protestations and lamentations was most amusing. He has the telephone all to himself now, and is not troubled in any way."

## American Institute of Electrical Engineers.

In the June and July *Transactions* of the American Institute of Electrical Engineers there appears a communication from Isaiah H. Farnham of Boston in reply to the discussion of his paper before the Institute on the "Destructive Effect of Electrical Currents on Subterranean Metal Pipes," which was published in the Western Electrician of April 28th. This contribution attracted considerable attention, and was discussed very freely. Mr. Farnham's latest communication is as follows:

I have read with a great deal of interest the able discussion in Chicago which followed the reading of my recent paper. The work of Professor Jackson and his assistants is of special service, as it ought to entirely dispose of the doubt heretofore existing in many minds that currents produced by small differences in potential are sufficient, and actually do cause corrosion of metal buried in the earth. I hope readers of this paper will not pass too lightly over this fact. If we appreciate the danger as it exists, we shall be more likely to apply a sufficient remedy, and we shall look for the danger in important places which otherwise may escape detection until too late to controvert serious loss. The Chicago discussion calls attention to serious effects of electrolysis upon metal-lined underground tunnels. How may it be with anchorages to suspension bridges, and to the iron feet of elevated railway structures, especially those employed to carry in a measure the heavy currents of the railway?[1]

Referring to A. T. Welles' remarks, I did accidentally confuse Cincinnati with Cleveland. It was unfortunate, as Cincinnati, having a good example of the double trolley system, might be expected to escape the trouble from electrolysis. This expectation would undoubtedly be realized but for the fact that there is also in the city a small electric railway system employing the single trolley.

I have but little criticism to offer upon the discussion. I

1. The most powerful and important agents in nature are slow in their operation.

agree entirely with all that has been said, both in New York and Chicago, as to the importance of large railway returns and thorough bonding of rails. Mind you, I do not say "ample" railway returns, for returns ample to prevent escape of current to the earth and adjacent pipes cannot practically be provided.

I am in hearty accord also with the able remarks of Mr. Abbott and others with reference to the employment of the "double trolley system," or in fact any system which maintains the entire circuit well insulated from the earth. My paper implies this, and to this end I have written several articles in the early days of the railway ventures.

I do not agree that it is as well to connect pipes to the rails within the danger zone or area as to employ a special return wire for relieving them. A careful study of the situation which may be met in large cities will make it clear that not only must the pipes have good conductors back to the dynamo, but that the potential of the earth about them must in some cases be raised above the normal condition; this can be accomplished in no way easier than by so proportioning the return system of the rails and the pipes as to cause a small passage of current from rails to pipes through the earth within the danger territory.

Nor do I agree with Mr. Armstrong, that the ground may have to be filled with copper to accomplish the remedy if applied as I recommend. A careful perusal of the paper itself and the New York discussion will make it unnecesary to explain further why a comparatively small amount of copper properly placed in the danger area will transfer the damaging action from the pipes to the railway system itself.

## Transmission and Distribution of Electrical Energy.[1]

We have always held the opinion that the hostile attitude assumed by some engineers toward the introduction of the alternating system some years ago was a most unfortunate thing both for those who supported the policy and for the business of electrical engineering in general.

The introduction of a new method, system or appliance may temporarily injure the prospects of the older and established practices, but invariably an increase in the total amount of business done very speedily ensues. Every fresh departure or real improvement hastens the growth of a new business, and it would therefore seem imperative that engineers, especially manufacturing engineers, should heartily welcome and encourage anything new, or differing essentially from present practices, if for no other reason than that they tend to extend the trade. Unless the new proposals are of the fraudulent or "wild cat" order, they, at any rate, do no harm. We had a notion that such views had been very generally accepted, and that the day when electrical engineers would publicly disparage a great line of electrical engineering progress was past. But, to our astonishment and regret, we find the old attitude struck by a well-known engineer at the British Association meeting on the discussion upon Prof. Thompson's able paper, "The Advantages of the Alternating Current." It is fanatical conduct at this date on the part of any engineer to pin his faith to one method or system, and condemn all others, although it may be good policy to make a specialty of one line of business; but damning every other in the same trade can only result in disaster.

The onward and triumphant march of the alternating system, despite the hostile position assumed by those who ought to have been its best friends, has compelled every manufacturing firm to produce machinery for both continuous and alternating current electric lighting plants. Thus anyone may plainly see that had it not been for the increase of trade, due to the introduction of the newer system, every firm would be engaged in building similar plants, with nothing to recommend the one over the other, but resulting in fierce competition; and many places now enjoying the advantages of an electricity supply would have remained without it.

We are gratified to find in Prof. Thompson an advocate not only of alternating current working generally, but particularly polyphase methods; in fact, his clearly expressed and favorable views entirely coincide with those we have so often expounded on the same subject. The polyphase system is highly praised by those who know it best, and although it has not yet, in this country, met with the same open hostility through which the single-phase method successfully passed, it has been treated even more shabbily by indifference, a sort of passive resistance even more deadly than active war. Now, from the business point of view, it must be obviously bad policy again to sit upon a new system, the introduction of which would add to the number of machines to be manufactured; for it is a system which would meet cases not covered by any of the others, so that it would be adopted in places where none of the others could, at present, come in with so many advantages.

In other countries polyphase machinery has already become a catalogued part of every manufacturer's trade.

It has been said that in the early days the manufacturers wanted capital more than engineers. Now they have got both capital and engineers; they want trade. The only way to secure this is to adopt new departures. Even such an unpromising field as that opened in electrical heating and cooking has proved a success, in so far as adding new manufactures to the electrical engineer's business. What would be said of the engineer, unless he pinned his faith to gas, who publicly came forward and denounced it as wasteful, costly, uneconomical, unnecessary, and so on? It is very easy to set up a case like this and demolish it utterly. Yet the fact remains that electrical heating is gradually and surely forging ahead.

There are, of course, fanatics on both sides of the distribution and transmission controversy—men who have one system, one plant, and in which alone they hold there are any good features. They would put it down anywhere and everywhere, regardless of circumstances. Such illogical beings are, however, becoming scarcer, happily for the prosperity of the electrical trades.

We have not far to seek for cases where the alternating system would have been better than the continuous, and *vice versa;* these examples are valuable, for out of them has come the experience to guide future practice in deciding upon a scheme suitable for any case. On this point we may sound a note of warning against the adoption of advice from any man who, in all cases, in season and out of season, advocates one method. In the present state of the art of electrical transmission and distribution, no level-headed, unbiased engineer would pin himself to the dogma that one system is sufficient to meet every case.

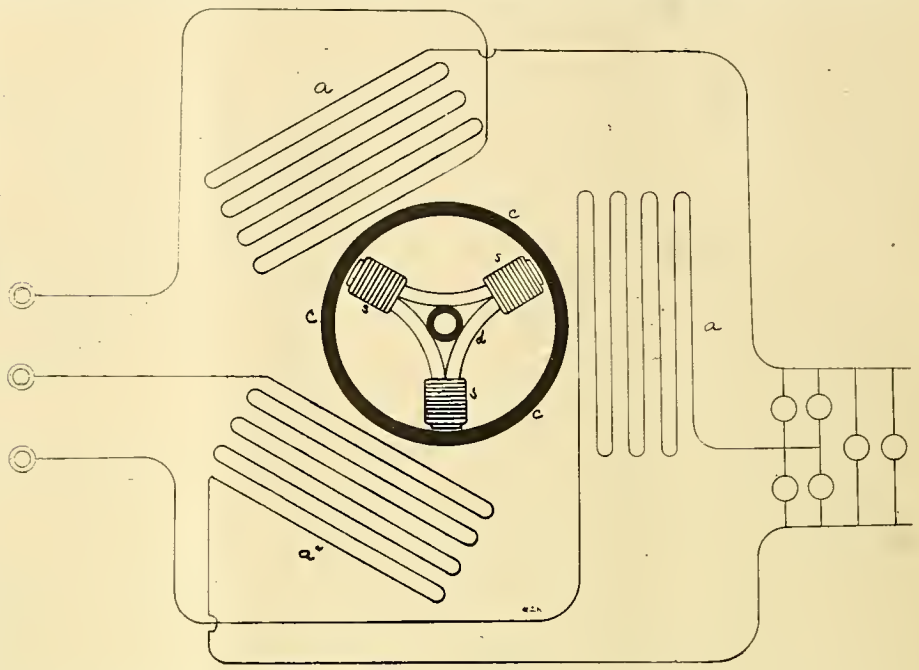



FIG. 9. DUNCAN METER FOR ALTERNATING CURRENTS.

In many instances now arising in connection with municipal plants, the district to be supplied is compact and narrow, no transmission to a distance being necessary; it is a case only of distribution, and as high pressure distribution has now been abandoned, all distribution mains are run from sub-stations or central stations, instead of, as on the obsolete high pressure distribution system, being taken from each consumer's own transformer.

Now in cases like this, with the central station in the district to be fed, there is not much in favor of high pressure being used at all. As we have to run low pressure mains all over the district, there can be little advantage in using high pressure, for the copper saved in the few short transmission mains which would be put in would be insignificant.

But, granted that in many cases now before municipal bodies high pressure is not necessary on account of the nature of the scheme and the now universal adoption of a network of low pressure mains for distribution, that does not settle the question whether the supply is to be continuous or alternating. Not by any means, for even on a low pressure, three-wire system alternating currents would in many cases show to vast advantage, not the least part of it being the facility which at any time or place a high pressure may be got, if wanted, within the district.

The battle of high pressure against low pressure has recently assumed a new phase, to which we wish to attract attention by the question as to how much is saved in an ordinary city or town plant by using high pressure for the few feeders and a mass of low pressure distributors in a limited compact district? The whole saving effected by high pressure is now reduced to that of the copper; not in all the mains, but only on feeders. To how much does that amount? We know it in some cases to be very small, so this view of the question is well worth discussion.

Only in great schemes of transmission to a distance, such as the Deptford system, is the adoption of high pressure a self-evident saving. To settle the point, high *versus* low pressure, we consider only the amount and distance of the transmission of the power or energy.

To decide upon the other and more important question as to the current to adopt is a more complicated matter, but one which is becoming clearer every day and which will be much simplified by such discourses as that of Prof. S. P. Thompson. The discovery of the wonderfully simple method of regulating the supply pressure on alternating mains by a synchronizing over-excited motor is one destined to still further recommend that system.

The more we consider the various advantages and drawbacks of the different plans, the more apparent it becomes that many plants are established without serious reflection; one place merely follows the lead of another or falls into the hands of the same one-system class of engineers.

The objection raised against the alternating system on the score that storage batteries cannot be used has no real foundation in fact, for if storage batteries were of such importance as to make their use a necessity, and if their employment would improve the economy, there are several

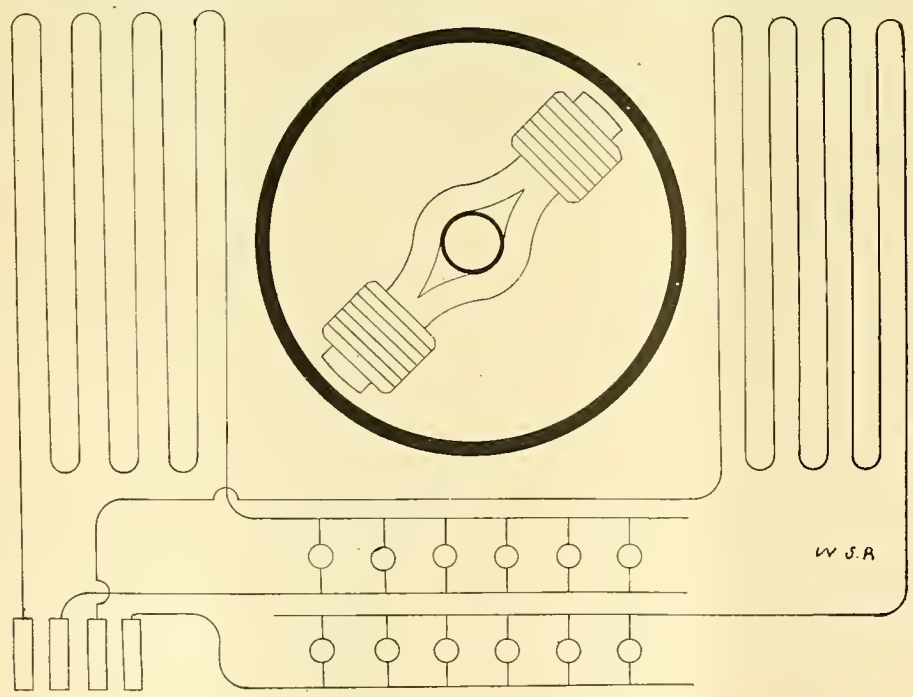



FIG. 8. DUNCAN METER FOR ALTERNATING CURRENTS.

1. From the London *Electrical Review*.

simple and well-known methods whereby they can be used with alternating systems, both single-phase and multiphase.

What amount of service is rendered by storage batteries used in continuous current stations is an unknown quantity. We know, from Mr. Crompton's tables, that they figure largely on the expenditure side of the accounts; but just what they do in return is apparently not so readily found out. Storage is very desirable on any system, so that if batteries as at present made can be shown to be doing work profitably, the makers and users would both gain by clearing up the doubts so often expressed regarding their value.

## Proposed Extension of Telephone Lines.

The financial writer of the *Boston Traveller* is authority for the following:

The Erie Telephone company just now has a vast amount of new construction on hand. It is extending its long-distance lines in all directions, besides putting its wires underground in all the large cities. Charles J. Glidden, treasurer of the Erie Telephone company, was seen at his office in Lowell yesterday by the writer, to whom he said: "We are now extending our long-distance, metallic circuit lines from Little Rock to Fort Smith in Arkansas, and, when this line has been completed, all the stations in that state will have been connected. In Texas we are putting up a line similar to the Arkansas line, from Sherman to Paris; another from Dallas to Waco and Austin, and from Austin to Houston. From Paris, north, we are building a line to Galveston, a distance of from 600 to 700 miles, the longest single line in our field. With the completion of these Texas lines all the stations in that state will be connected by telephone. In the Northwest we contemplate the building of a line from St. Cloud to Fargo. All our wires in Minneapolis and St. Paul are underground, and the work of burying the wires at Cleveland is going on rapidly. At Cleveland, also, we are erecting a new large central exchange building. At the present time we have 1,500 miles of line under construction, having completed this year some 500 miles. Our total mileage, when what is now under way is completed, will be 7,000 miles, of which over 5,000 will be underground."

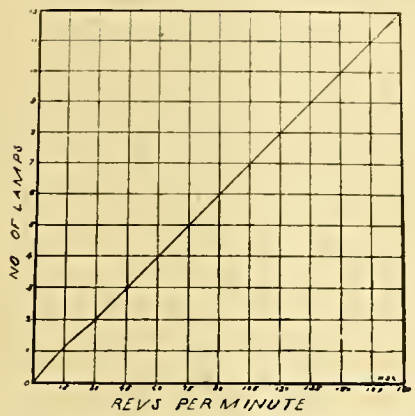



FIG. 4. DUNCAN METER FOR ALTERNATING CURRENTS.

Mr. Glidden said that his company had not been troubled with competition on account of the expiration of the original patents. The Erie company rents to its subscribers the telephone for $1 per year for private lines, and the only competition so far has been the erection of a few private lines, which in reality do not compete at all. He did not think that there would develop any serious competition in the telephone field because of the amount of cash required to establish a plant which would be of sufficient magnitude to satisfy the public demand.

## Advantages of Electricity in Coal Mining.

One of what may be called the secondary results of the recent strikes, says *Black Diamond*, the journalistic representative of the coal trade in Chicago, has been the attraction of more attention to the important subject of the adaptation of the use of electricity as a motive power in the mining and handling of coal. This country, ever in the forefront of inventive genius and professional enterprise, always seeking new methods of improvement in the economy of industry and of trade, was the first to appreciate the super-abundant opportunities which were allied with electrical science, not only in saving time and labor but also in saving money in the expenses of business. This early demonstrated itself as soon as some conception was obtained as to the means for utilizing electric force. It was discovered that there was a certainty, a regularity and a perfection of control in this agent that belonged not to steam. So far as coal mining is concerned there can be no question, and it is readily recognized by practical men that with the necessary safeguards it is the safest possible element to depend upon for power. Coal mining is different from any other class of mining, embracing dangers which are common to itself—dangers of a character that are calculated at any time not only to jeopardize but to entail the destruction of both life and property. Despite all precautions which may be taken to obtain the safety and security of a mine, there may be at any moment an accumulation of gases which some untoward incident may eventuate in an explosion. It is not only in the breaking of a lamp that we have a deal of trouble, but in the fact that the majority of miners are inveterately allied to habits which induce them, for the gratification of a momentary pleasure, to risk their own and others' lives. There is a possibility in the application of electric lighting to mines to avoid in a great measure and to reduce, as it were, to an infinitesimal degree, dangers which may arise from this particular source. Electric lighting by incandescent lamps has been introduced with unquestioned and unquestionable success in mines both east and west, and the fact that the ground has been broken in this particular would warrant the belief that the day is rapidly approaching when it will be the sole and only luminant in the recesses of a mine.

It is not, however, only in this direction that electricity has manifested its peculiar advantages in its association with coal mining. Its most prominent connection has been with mining machinery. There are a number of devices in constant and ever increasing use, and their record has been of a nature which has opened for them a wide domain of trade. While we shrink from characterising in a general sense a man as being a human machine, we can designate him as such in a polemical sense for purposes of contrasting him with the mining machine. The electric coal cutter cannot strike, is more to be depended upon than its human antithesis; and in these days when we have to recognize the precariousness of labor a factor of this kind is a most important adjunct in the successful conduct and management of a business or an industry. One might expatiate to a considerable degree as to the specific virtues and advantages of this mining machine. Without doubt, after the preliminary expense has been incurred, it proves in practically every instance to have been a profitable investment. Coal can be saved, can be mined cleaner, and can be transported to greater distances with less loss from friability, than that which is mined by hand. Hence it is that if two coals of the same name and of the same grade are mined in the same district and one is mined by hand and the other by machine, the latter invariably looks the cleaner and the better, and is calculated to be the more popular with the consumer. When competition as a law of trade is so keen as it is at present, every little point which can be made plays an important part in the successful headway of a specific coal. Perhaps there is no trade or industry in which so many interests conflict and clash as there is in the coal trade. All the great distributing centers of the country, and especially New York and Chicago, seem to be in many senses a kind of dumping ground for innumerable coals. Under such conditions as these the producer who has the most advantages in the mining of his product is the one who has the best of chances for its profitable disposition. Hence it is that electricity as a power in mines is being more and more appreciated and ever increasing its sphere of utility. Enterprising producers have recognized that it has been, as it were, a special dispensation to those who are quick to grasp a conception of its advantages.

One might continue to elaborate upon the many ways in which electricity might be utilized in every avenue and department of coal mining and coal handling; but the main point which it is wished to demonstrate is that it is time saving, labor saving, money saving, and an invaluable aid to those who are engaged in the industry of coal mining. The very fact of itself that it can at once increase the productive capacity of a mine, enabling a far greater amount of coal to be got out of the shaft inside of 24 hours than would be possible under any other circumstances, thus decreasing the average expense of investment and of office and other charges, is an illustration in this direction. Manufacturers of devices to which application of electricity is possible have before them a wide and fruitful field for business expansion if they make the effort to obtain it. Thus it is that we feel confident the day is rapidly approaching when electricity in relation to coal mining as a motive power will be the chief and prominent factor.

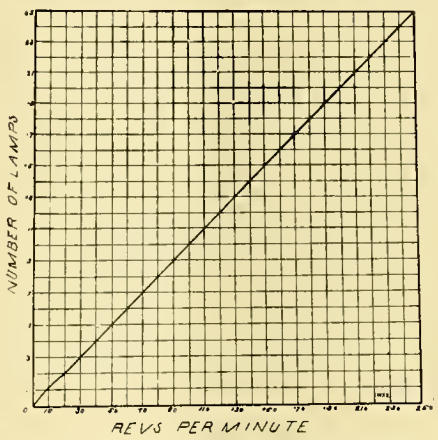



FIG. 5. DUNCAN METER FOR ALTERNATING CURRENTS.

## Inductive Telegraphy and Telegraphic Communication Between Lightships and the Shore.[1]

At the meeting of the Society of Arts, in the discussion following a paper by E. O. Walker, on "Telegraphic Communication with India," one speaker said, "I don't know much about submarine cables, but I should think land lines were better" (!) and in this several others who took part in the discussion appeared to agree—possibly on the same grounds. In this instance, the question was whether a land line through a thickly wooded desert country, or a submarine cable in shallow water and on an even, soft, bottom was the best adapted as a means of communication.

Notwithstanding the difference in initial cost between a land line and a cable, we were not, on the occasion referred to, able to agree with these gentlemen in their preference for an aerial line.

In cases, however, where inductive telegraphy is found to be practicable, the matter stands on a different footing entirely, and there is no doubt that the experimental investigations of C. A. Stevenson, F. R. S. E., on "Signaling Through Space," referred to in our last issue, and previously of W. H. Preece, F. R. S. (following on others of Willoughby Smith and W. P. Granville, besides those undertaken by W. F. Melhuish across Indian rivers), have a most important practical bearing on commercial telegraphy.

1. From the *Electrical Review, London.*

The direction in which these experiments (sometimes popularly described as "telegraphy without wires") are likely to be turned to the best account in practice in the immediate future is presumably in connection with telegraphic communication between lightships and the shore, where great difficulty is experienced in maintaining electro-telegraphic communication by means of submarine cables, owing to the cable getting chafed against the moorings of the lightship, and owing to the bottom in such regions being so unfavorable to a cable—indeed, the very reason why telegraphic communication is required at all is due to the somewhat frequent occurrence of wrecks in the immediate vicinity, the lightship itself being usually placed to mark a reef of some sort; if, moreover, a strong current prevails, as is not uncommonly the case, the cable is liable to get shifted and twisted up with the lightship moorings.

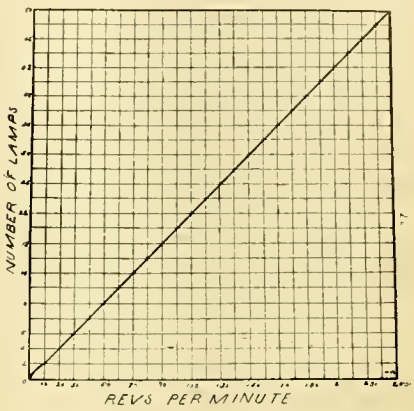



FIG. 6. DUNCAN METER FOR ALTERNATING CURRENTS.

The Telegraph Construction & Maintenance company has made a special study of this subject, but notwithstanding several ingenious devices of F. R. Lucas, Commander F. Bedwell, R. N., and others, the objections named have not so far, we believe, been entirely overcome.

It will be observed, therefore, that one obvious solution of the problem will be—if it be possible, as demonstrated by the aforesaid experiments—to carry on these electrical signals between lightships and the mainland without any cable whatever running between the signalling points.

The same practical field for these investigations appears to apply in the case of electrical communication across rivers, and such like, in which the bottom (for one reason or another) is so unfavorable, or the danger of abrasion from anchors or moorings so great, that the life of a submarine cable across it would be of too problematic a character.

The distances between which signaling by inductive telegraphy can be successfully performed in practice is, of course, the only point in question. At present this distance seems to be of a somewhat limited nature, though in the recent experiments carried out for him by J. Gavey and H. R. Kempe, Mr. Preece appears to have successfully effected communication at far greater distances than had been previously attained. The results of these experiments were made public at a recent meeting of the Society of Arts and rendered palatable to the audience by Mr. Preece in a manner in which he alone knows how.

Perhaps on a future occasion Mr. Preece will be able to actually furnish us with some law giving the maximum distance at which telegraphy or telephony of this description is practicable, and what relation this distance must bear to the length of wires ashore, whether parallel to each other or otherwise. Possibly, some day, when further light is brought to bear on the subject, we may be able to signal in this way for many hundreds of miles across the ocean without any submarine cable between the signaling points, but, for the present, the cable-constructing companies, as well as telegraph engineers and electricians, may be thankful that this time has not yet arrived!

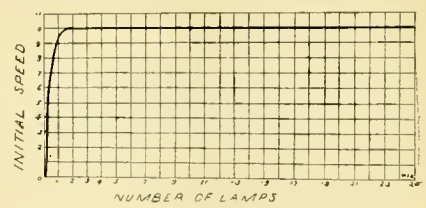



FIG. 7. DUNCAN METER FOR ALTERNATING CURRENTS.

In this connection we would venture to ask Mr. Preece and others treading in the same paths of investigation to try to unearth some other title for any future experiments of the sort, if only on behalf of shareholders of cable manufacturing companies who are liable to be alarmed at the near prospects of "telegraphy without wires." In point of fact—as put by Charles Bright at the meeting referred to—it is, in reality, a case of the wires being laid more or less parallel to one another, and being of a length more or less corresponding to the distance between the points of signaling instead of from signaling point to signaling point. At any rate, it looks as though material lengths of cable or wire will still be required! At the same meeting Alexander Siemens mentioned what seems to be a sufficiently good reason for explaining the phenomena as due to electromagnetic induction rather than to conduction, thereby upholding Mr. Preece's explanation of the same—by the ether theory—rather than Mr. Granville's.

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THE severe electric storms that have visited all sections of the country during the last week have wrought considerable damage, especially on telephone and telegraph lines. In several instances, too, trolley lines and electric light plants were disabled. All of which indicates the necessity of general improvement in construction work and a more extensive use of first-class lightning arresters.

VERDICTS of coroners' juries are not conclusive by any means, yet when such a body recommends the indictment of officials of an important corporation its action deserves consideration. Elsewhere in this issue is recorded the finding of a jury which investigated the cause of death of a Brooklyn boy. The fatality was attributed to the type of fender used, but the officials of the street railway company claim that this fender was recommended by the state railroad commission. Had this fact been known to the jury it is possible that it would have recommended the indictment of those officials instead of the street railway men.

TROLLEY parties are the latest fad in Philadelphia, and the street railway companies often find difficulty in supplying cars for those who desire to indulge in these excursions. On one evening recently forty cars were detailed by one company for this service, another evening thirty-three, and during the last two weeks the demand has ranged from twenty to thirty. There has been no evening in several weeks when less than twelve cars were chartered by private parties for little trips to different points of interest. On more than one occasion the company have found it impossible to supply the number of cars ordered without crippling the regular service.

A CURIOUS item appeared in the daily papers of Chicago last week, chronicling the "capture" of an alleged wire tapper. A private detective at Hawthorne track noticed a "suspicious-looking" man about the track inspecting the telegraph wire. Two policemen were detailed to watch him. After leaving the track the man was followed, and later the place he had entered was invaded by the officers and the "man in charge and his tools were captured." The "tools" were said to be electrical devices, and it was assumed that the man was a wire tapper. This suspicion of the police may prove correct, and they may have in their possession other evidence against the prisoner. Otherwise the proceeding was a high-handed outrage and one which should be promptly and effectually resented.

SELDOM is so great enthusiasm shown over proposed public improvements as that which marked the beginning of the work of construction of the West Jersey Traction company's trolley system at Haddenfield last week. The improvement is an important undertaking in many respects, as it marks the beginning of the establishment of an extensive system of communication between the towns of that section. It is not to be wondered, therefore, that many men of prominence in the locality were present to participate in the opening exercises. Ground was broken by a prominent resident of Haddenfield, a gold bar being used on the occasion instead of the conventional pick. Speeches were made in a spirit befitting the occasion, and the people showed that they fully realized the importance of the project. It is to be regretted that the same friendly disposition is not always displayed where similar improvements are projected.

CONVENTION season is at hand, and in many of the states street railway and electric lighting associations are assembling to listen to and discuss papers on topics of interest to the profession, and to determine plans for meeting adverse legislation. In Pennsylvania especially, where the trolley system has made such remarkable progress in the last year, the state Legislature threatens to enact measures inimical to the interest of the industry. To oppose this movement the state association should present a solid front and resist every attempt to encroach upon or restrict the rights and privileges of the members. The New York association and other state bodies should also guard their interests jealously. With adverse legislation threatened, the members of these organizations should make an extra effort to attend the meetings and show by their presence that they are in sympathy with the aims of the association.

A SERIES of communications has been printed in a prominent New York daily, containing suggestions for the guidance of the constitutional convention which has been in session in that state for some time. These communications discuss "State Taxation" and the "Relation of Corporations to the Public." It is not expected that these contributions will have much weight with the members of the convention, if indeed they are read by them. A much more practical way to bring the subjects discussed prominently before the convention would be for the companies interested to be represented by a delegation, or by lawyers who would command the attention of the assemblage. There has been a great deal of time wasted in discussing these questions where no possible advantage could be gained, the men appealed to being of one mind with the advocate. What is wanted is practical work in the Legislatures and municipal councils where there are men who do not, or will not acknowledge that they do, appreciate the folly of attempted interference on the part of the government in the management or control of public enterprises.

IN attempting to avert German prejudice against his book, "Modern Views of Electricity," which appears to have been aroused, in some measure, by the idea that electrical investigators of that nationality had been slighted, Prof. O. J. Lodge, the British physicist, is in danger of running full tilt against the American electricians. In a letter to *Nature*, intended to sooth the wounded pride of the Germans, Prof. Lodge says: "When I said that the four great names in connection with our partial knowledge of the nature of electricity were (excluding living persons) Franklin, Cavendish, Faraday and Maxwell, I ought to have interpolated the adjective British before the word 'names' in order to avoid entering upon much larger questions than were at all appropriate to the expository course of lectures on which the book 'Modern Views' was based." This will naturally excite the question on this side of the Atlantic, When, pray, did Franklin become a "British" name? Benjamin Franklin was, of course, a native of Massachusetts and a devoted American patriot as well as a distinguished philosopher. It is rather cool, to say the least, to claim him as "British" at this late day. Prof. Lodge should qualify his list a second time.

THE electrolytic purification of sugar juice is advocated by Dr. W. Bersch in *Sucrerie Indigène* in which he publishes the results of his experiments at the Hoym Sugar Works at Anhalt, Germany, with the Schollmeyer-Behne-Dammeyer process. The sugar juice coming from the diffusers at a temperature of 40° C. to 45° C. is heated up to about 65° C., and passed into a rectangular iron tank divided into two equal compartments, of such a size that 330 gallons of liquid occupy a depth of about 18 inches. In each compartment there are seven zinc anodes of a total surface of 64½ square feet. The two compartments are alternately filled with juice, which is submitted for about ten minutes to a current of from 50 to 60 amperes at six volts. A gray-green gelatinous substance is deposited at the cathode, which can be scaled off when necessary by reversing the current for about five minutes. At Hoym, Germany, it was found that in defecating electrolyzed juice 1 per cent. of lime accomplished the work of the 3 per cent. or 4 per cent. required in the case of non-electrolyzed juice. According to Dr. Bersch, the broad result of the electrolytic treatment is that a better quality of refined juice is obtained, and that this is done in less time and with greater facility than formerly. The first cost of the plant at Hoym was paid for in a week by the superior economy of the process, it is claimed.

THE passengers in a Baltimore trolley car had an exciting experience on a trip through South Baltimore a few days ago, if the press dispatches sent out from that city are to be relied upon. It appears that the car was proceeding at a rapid rate, when the trolley wire broke, and before the speed of the car could be checked the wire became badly entangled about it. The car, still on the rails, of course, thus became a portion of the short-circuit on the line, and every piece of metal in it was charged with electricity. The woodwork of the car caught fire in several places and sparks could be seen in all directions. After a time the motorman succeeded in stopping the car, but not before the thirty passengers had been thrown into the wildest state of excitement. Women struggled to get out, and several were slightly injured by jumping from the rapidly moving car. After it was all over, however, it was found that no one was seriously hurt, although there were bruises and torn garments in abundance.

Fortunately, accidents of this character are very rare indeed. We are not informed of the cause of the breaking of the wire, or whether the overhead construction was well built and in good order. Of course every possible precaution should be taken to prevent such accidents, and it would be interesting to learn how this one occurred. With proper line construction, however, it is difficult to see what safeguard could be added to those now employed.

THE telephone situation in England is by no means satisfactory, despite the recent advantages gained by the people who have been opposing the monopoly. According to the *Pall Mall Gazette*, this state of affair exists. "One association, the National Telephone company, owns nearly all the wires and exchanges in the towns, and transacts 95 per cent. of the business. The postoffice has rival telephones, but attracts little custom, and finds its revenue from telegraphs rapidly declining. It has, therefore, persuaded the government to set aside a million for the purpose of buying the existing trunk lines (of the company) connecting various towns, and of constructing new trunk lines." It is claimed, however, that this is the worst possible arrangement for the people, as "all the remunerative business will be left to the company, while the government will pick up the bones which the company flings to it." The profitable business of the large cities will remain in the undisturbed possession of the company, while the government is extending the system of inter-communication, connecting all the important points of the country at great expense and with little chance for remuneration, at least not in the near future.

It is conceded by the telephone company that the service is defective; it is claimed by the subscribers that it is wretched. Whether it would be improved if it passed under the direction of the government is questionable. The subscribers seem to think that the service would be cheaper, at any rate, but it is doubtful if it could be made self-sustaining if taken in hand by the government.

## Influence of Arc Light Carbons on the Candle Power.

By W. M. Stine.

The London *Electrical Review*, commenting on the statements made at the Philadelphia meeting of the American Institute of Electrical Engineers concerning the actual candle power of arc lamps, says: "It has long been known that the quantity of light from an arc materially depends upon the quality of the carbon used, though we are not aware that any comparative experiments have ever shown anywhere as great a difference as here mentioned. We have been informed, however, by an arc light station superintendent of wide experience that it is not unusual to come across carbons that will show a difference of 50 per cent. in the amount of light produced. As this is a matter of much importance to superintendents of arc stations and users of arc lights, we trust that one of our college laboratories will take advantage of the excellent opportunity it offers for investigation and experiment." There is, in fact, too little reliable data obtainable on this subject, and this is all the more singular since it is a matter of such moment. The same percentage of variation in incandescent lamps would cause much dissatisfaction among consumers.

The comment just quoted has caused me to refer to a report of a careful test made in the laboratory of Armour Institute during the last year on the comparative candle power of a number of brands of arc carbons. All the tests in the table herewith presented were made with the same lamp, under the same conditions and similar photometric measurements. The carbons were all 7-16 inch.

COMPARATIVE CANDLE POWER OF ARC CARBONS.

| Make of Carbon. | Class. | Average Current | Average E. M. F. of Arc. | Average Watts. | Average mean horizontal C.P. | Variation of C. P. in Brand of Carbon. | Variations of Make | Variations in Watts | Variation in percentage of Watts. | Variation in percentage of C. P. |
|---|---|---|---|---|---|---|---|---|---|---|
| $A_1$ | Solid | 9.81 | 48.6 | 477 | 454 | 99 | | 100 | 0 | 1 |
| $A_2$ | Solid | 9.6 | 48.9 | 469.4 | 442 | 97 | | 97 | 3 | 3 |
| $A_3$ | Solid | 10.1 | 45.9 | 463.4 | 426 | 100 | | 97 | 3 | 0 |
| B | Cored solid | 9.8 | 47.3 | 458.7 | 365 | | 71 | 95 | 5 | 27 |
| C | Solid | 9.6 | 47.3 | 454 | 372 | | 82 | 95 | 5 | 18 |
| D | Solid | 9.9 | 46.1 | 456.3 | 372 | | 82 | 95 | 5 | 18 |
| E | Solid | 9.8 | 45.4 | 445 | 359 | | 79 | 93 | 7 | 21 |
| $F_1$ | Cored solid | 9.54 | 43.5 | 414.9 | 293 | 93 | 64 | 87 | 13 | 36 |
| $F_2$ | Solid | 9.52 | 9.52 | 42.6 | 311 | 100 | 70 | 89 | 11 | 30 |

There is probably no one thing connected with electric lighting so unsatisfactory as the carbons with which the market is generally supplied, and the improvement in them has by no means kept pace with that in the lamps in which they are burned. Perhaps the cause for this lies in the fact that the physics of the voltaic arc is so little understood. If it were clearly proven that the carbon was actually volatilized, or that it was simply carried from the positive carbon to the negative mechanically, and rendered incandescent during its passage, the makers would have a definite aim in their selection of materials and methods of manufacture.

## Indictment of Brooklyn Street Railway Officers Demanded.

The sensational verdict returned by a coroner's jury at Brooklyn last week denouncing the officers of the street railway company, and charging them with responsibility for the death of a lad named John Walker, was the principal topic of conversation in street railway circles. The verdict is as follows:

We find that John Walker came to his death from shock and injuries due to being crushed under and by trolley car No. 344, Fifth avenue division Atlantic Avenue railroad, on Fifth avenue, at Twelfth street, on August 30, 1894. We exonerate the motorman and conductor from all blame, but strongly censure the Atlantic Avenue Railroad company for gross carelessness in running their cars without the proper protection for human life. We recommend the indictment of the officers of the Atlantic Avenue Railroad company for the loss of the life of the said John Walker, and we appeal to Mayor Charles A. Schieren to see that no car be allowed to run in this city after November 1, 1894, without having proper life preservers attached to it.

Mayor Schieren, when notified of the action of the coroner's jury, said he had no power to specify what type of guard be used on trolley cars. The district attorney has promised to call the attention of the grand jury to the verdict.

An officer of the Atlantic Avenue company says that no safe fender has yet been invented. "There are over 2,000 patents on trolley car fenders," he said, "but not a single one has proved to be of any use whatever. We are trying new fenders every day, and hope to get the right one sooner or later. The one we have in use on the cars at present was recommended by the State Railroad Commission."

During the year ending June 30th it is reported that there were twenty-there persons killed and thirty-nine injured on the various Brooklyn City Railroad trolley lines. Of those killed two were passengers and three employes.

## Queen & Co.'s Affairs.

The committee representing the creditors of Queen & Co., Philadelphia, has issued a circular in which it announces that it will be several weeks before a complete statement of the company's affairs can be presented. The circular says:

It is proper to state that the business embraces nine departments, some of which include as many as twelve thousand different articles, and it would be out of the question to properly value all this stock without an examination of the items composing it by competent experts.

Under the assignment which was made, the assignee has been proceeding to sell from day to day for cash. This course has been approved by your committee, and they think it should be continued until a final determination can be arrived at as to what course is to be pursued.

On the 30th ult. the court appointed as appraisers of the estate Joseph C. Ferguson, Jr., and Charles H. Flaig, both of whom are in similar business. It will be their duty to proceed with the inventory and appraisement of the goods as rapidly as possible, and your committee has urged upon the assignee the necessity of getting this accomplished with the utmost dispatch. Your committee cannot make a report upon the matters with which they were charged until this is done.

The assignee has made an estimate of the value of the stock, placing it at $104,000. The committee was informed by the counsel of the assignee that this was done for the purpose of complying with the statute requiring the assignee to file an inventory and appraisement within thirty days of the assignment, but it is also understood that the appraisers will go on with the minute examination of all the items of the estate. This will probably require three weeks. When this is completed it is understood that the assignee will file a supplementary inventory and appraisement showing the facts as they may then be found by the appraisers. When this is done the committee will be better able to advise the creditors as to the course which it may deem best to be pursued.

## Electric Searchlights and Torpedoes.

A dispatch from Newport, dated September 7th, says that the torpedo boat Cushing left her dock at the torpedo station the previous evening for practice in searchlight work. There were three objects in view when the boat left the torpedo station. The first was to give the class of seamen gunners at the station practice in keeping the searchlight on rapidly moving objects; second, it was desired to determine at what distance it was possible to distinguish the Cushing in her present color with the searchlight in its present position and the boat in its direct rays.

The torpedo boat steamed up under the shore and then ran into the full rays of the light, which was pointed directly out through the channel to sea. At a distance of a thousand yards it was light enough to read on board the Cushing, but she was not discernible from shore by those who had kept their eyes upon her from the time they were within hailing distance. When she disappeared from view rockets were discharged from the station as a signal for those on board the Cushing to make plottings of their position.

The third object was to determine at what distance without the aid of the light, the torpedo boat could be located by the noise of her engines, swash of water from her propellers, or other necessary conditions in the running of the ship. There was not a ripple on the waters of the bay, but the bright moonlight was somewhat against the boat. In this test the observers first discerned a few sparks in the vicinity of Rose Island. Then more sparks were seen, and it did not take long to determine that they were from the Cushing's funnels. Soon the swash of water was heard but it was several seconds before, with the aid of the searchlight, whose rays were at once turned in the direction where the sparks were seen, the boat herself could be sighted. Plottings were again taken upon signal, and it was found that she was about 800 yards away when first sighted by the electric searchlight.

Eight hundred yards is the maximum torpedo range, and a speedy craft would make great progress inside of this before guns could be trained upon her; so it it still considered questionable by naval officers whether the searchlight is much of a safeguard against an attack from torpedo boats.

## Pennsylvania Street Railway Association.

The annual meeting of the Pennsylvania Street Railway association was held September 5th and 6th at Reading. The attendance was large and the delegates and guests were well cared for.

The meeting was called to order by the vice-president, Robert E. Wright, of the Allentown & Bethlehem Rapid Transit company, who made a feeling allusion in his annual address to H. R. Rhoads, the president, who died within the last year. Papers were read by Lincoln Nissley, of the Citizens' Passenger Railway company of Harrisburg, on "Street Railway Motors," and by L. H. McIntire, of the People's Traction company of Philadelphia, on "Power Stations." It was voted to receive supply men as honorary members.

The following named officers were elected for the ensuing year: President, John A. Rigg, Reading; first vice-president, Robert E. Wright, Allentown; second vice-president, G. A. Greenwood, Pittsburg; secretary, S. P. Light, Lebanon; treasurer, W. H. Lanius, York; executive committee, Chris. L. Magee, Pittsburg; B. F. Myers, Harrisburg, and J. J. Patterson, Lancaster.

In the evening the delegates and visitors took a trip in a special car provided by the Neversink Mountain Railroad company and visited the power station of the Reading Traction company on Seventh street. The visitors were shown about the plant by J. L. Boyer, superintendent of the Metropolitan Electric company, and John A. Rigg, president of the Reading Traction company. The railway current is generated by a multipolar General Electric generator of 375 kilowatts capacity, coupled directly to a Lake Erie 600 horse power vertical engine, and a 300 kilowatt multipolar generator, made by the General Electric company, belted to an M. A. Green engine. The lighting plant consists of Wood and Thomson-Houston arc and Edison incandescent dynamos, power for which is furnished by six Ide engines and one 1,000 horse power Hamilton-Corliss. The party visited the Mineral Springs Park, where a band concert and other entertainment was enjoyed.

On the following day the visitors enjoyed a number of excursions arranged by their Reading hosts.

## Temporary Insanity Caused by an Electric Shock.

The following interesting account of an accident at Detroit on Monday is taken from the *Chicago Herald:*

Frederick J. French, an electric light trimmer, received a shock and became a raving maniac this morning while at work at the top of the slender iron tower in front of the city hall building. The tower is 175 feet high and provided with an elevator. After reaching the platform to change the carbons, French stretched out his hand and touched one of the lamps. Then he fell back in a sitting position, with one hand extended and resting on a piece of the framework. A minute later the man's arm dropped helplessly by his side and his hat fell off, then he collapsed and lay sprawled out on the platform, with one leg hanging over the edge. A few curious people had noticed his peculiar movements, and in a short time the Campus Martius began to fill up with spectators. Somebody notified the office of the Detroit Electric Light & Power company, and several employes hurried to the spot. The first man who arrived was A. D. McClellan. As the elevator was at the top of the tower McClellan had to climb up on the iron projections or footholds used for that purpose. He was closely followed by another employe.

It was a long, weary climb before McClellan reached the platform, where French lay flat on his back, frothing at the mouth and gibbering meaningless words. When McClellan tried to raise him he made several attempts to bite his hands. Luckily McClellan had on a pair of thick rubber gloves. After a long struggle the two rescuers managed to load French into the elevator, tying his wrists to the framework so that he would be unable to jump out. McClellan then remained on the platform while the other man got into the elevator and began lowering away. Several men stood in the framework near the bottom of the tower helping to steady the elevator. By this time the campus was literally packed with spectators, there having been no such crowd since the Prince Michael riots, two years ago. Street cars and wagons were blocked on all the thoroughfares that crossed at this point. Probably 10,000 persons stood in the mud and drizzling rain and watched the rescue. Several policemen cleared a small space under the tower and kept the crowd back for fear something might fall.

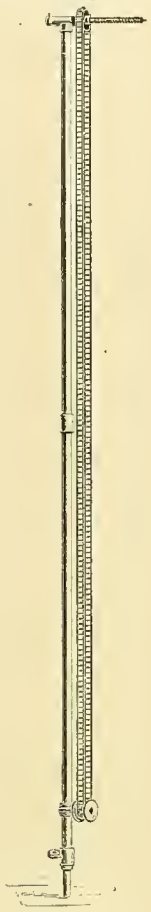
The elevator at last got to the bottom, and half a dozen men tied a rope around French's body, lifted him out of the elevator and slid him down a ladder the rest of the way to the ground. French was still crazy. His hair stood up straight, his face was distorted by a ghastly grin, and he kept muttering incoherently to himself. On reaching the ground he was turned over to the ambulance surgeons and taken to Harper Hospital.

The hospital physicians reported this noon that French would be all right in a day or two. He was doing well and had recovered his wits. The only marks showing where he was shocked were two small burns, one on the hand and one on the leg.

## Metropolitan Specialties.

Two simple devices designed to facilitate the work of wiremen and placed on the market by the Metropolitan Electric company of Chicago are herewith illustrated. The aulotron is intended to insert wire in wood. It is a departure from all previous appliances of the kind and is durable and easily handled. It will form a useful addition to the wireman's outfit.

The link-belt boring machine is intended for boring holes in overhead joists or girders without the use of a ladder. The workman, having adjusted his machine to

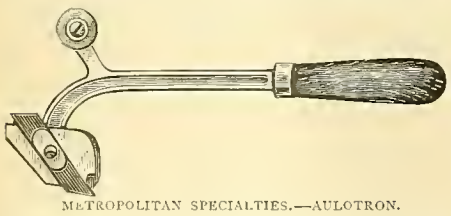


METROPOLITAN SPECIALTIES.—LINK-BELT BORING MACHINE.

the height of the ceiling by the adjustable extension at the bottom, stands in an easy position on the floor and placing his machine in position grasps it with his left hand, and presses the bit against the joist. With the right hand he grasps the nearest chain and draws it down. This imparts a rapid motion to the bit, and a very few movements of the hand bores the hole through the joist; then, by grasping the other chain, the bit is turned backward, and comes out easily. The outfit is light and is easily moved from one joist to another. The speed of this machine is remarkable, as six holes per minute can be bored through a two-inch joist.

## Electricity on War Ships.

There seems to be a general tendency to substitute electricity on board of war ships in the place of steam power wherever practicable, and so general has been the adoption that there are but few auxiliary engines worked by steam, says a Washington dispatch. It is now proposed to introduce electric power for moving the great turrets in which the heaviest guns are installed, and last week an experiment was made with the new system on board the old Montauk at Philadelphia, which proved so successful that the chief of ordnance will apply the motor to the turrets of all the new vessels which are not too far toward completion to prevent it. To determine the value of the electric gear, the turret of the Montauk was so arranged that the conditions would approximate to those under which modern eight-inch turrets would have to be operated, and the machinery used in



METROPOLITAN SPECIALTIES.—AULOTRON.

the experiment can actually be transferred to any of the turrets of the new ships. One of the salient features of the system tried is the use of a single operating switch lever for both elevation and training, which enables the operator to perform both motions at the same time with one hand, leaving the other free to fire the gun.

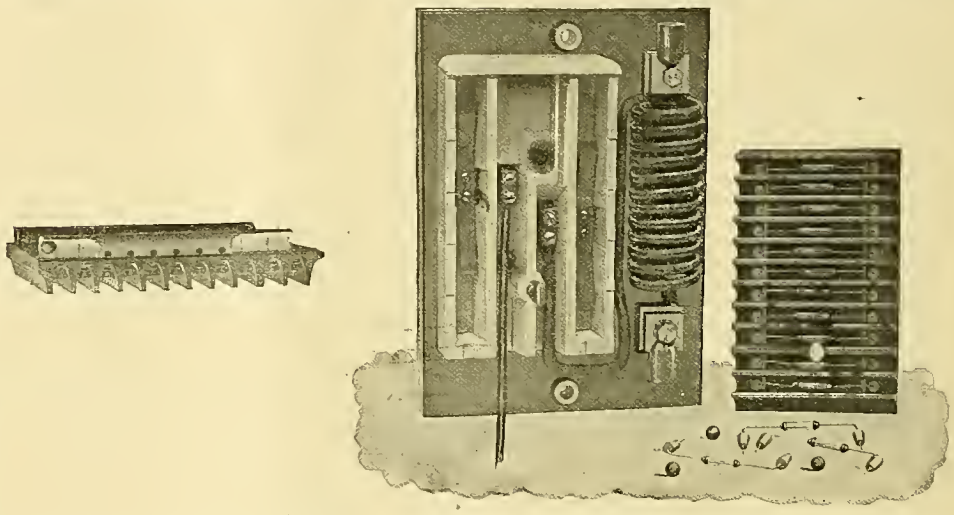
## Multiple Fuse Arresters.

Lightning arresters differ, as do the circuits they are intended to protect, or according to the ideas of their designers as to the best means of preventing or rupturing the arc which may follow a lightning discharge across the air gap between the discharge points. If all circuits were purely metallic, and the insulation to ground could be maintained well into the megohms, lightning protection would be a comparatively simple task, for there would then be no tendency toward arcing of the generator current at the discharge gap. Experience teaches, however, that electric circuits "don't stay put," and that high insulation is rather the exception than the rule on many of them, which is very detrimental to the discharge gaps of the arresters.

FIG. 1. MULTIPLE FUSE ARRESTERS.

Wider discharge gaps have been used to avert this trouble; mechanical and magnetic contrivances have been resorted to with varying success; but, whenever the discharge gap of any arrester that is connected to one side of an electric circuit having a "ground" on the other pole, is operated upon by a static discharge, the discharge points are always more or less injured by the consequent arcing of the generator current. It must, therefore, follow that one pair of discharge points will not remain intact when used on circuits of this class, as at each successive discharge the points are appreciably affected, and rendered less sensitive to the passage of the next discharge. This is particularly true of arresters on single trolley railway circuits, where one side of the circuit is always grounded; and not infrequently the arrester is entirely destroyed by arcing.

In view of the difficulty attending the preservation of the discharge points of any arrester with a small air gap (and arresters must have small gaps to protect the finely wound coils of measuring instruments, as well as armatures and field coils), an idea presented itself, that a succession of very sensitive discharge points, one for each discharge, might be made more efficient and reliable for a given number of discharges than any one pair of points could be.



FIGS. 2 AND 3. MULTIPLE FUSE ARRESTERS.

The Ajax arrester, illustrated herewith, is of the latter type and consists chiefly of a porcelain arrester box, with a fibrone cover containing eleven fuse dischargers. The fuse, Fig. 1, consists of two pieces of No. 26 brass wire, each about three inches long, having a single silk insulation and laid side by side for about one inch, as are consecutive coils in an armature. The one-inch lap of the wires offers abundant surface for the discharge gap, which is formed by the two thicknesses of silk and amounts to little more than .002 of an inch. Small pellets of a highly insulating wax secure these wires in the above position and a small glass tube is hermetically sealed over this part of the fuse to keep the dischargers clean and dry until used. The extreme sensitiveness of this part of the apparatus is made possible by its being called upon to act but once. The soft rubber plugs serve to hold the fuse in the corrugated cover of the arrester, and the bare ends of the wire project through the cover, ready to be brought into contact with the line and ground terminals.

Into the back of the cover are pressed two strips of metal—one a plain flat strip, to which is connected by a long clamp one end of each fuse; the other U-shaped, and into it the remaining ends of the fuses project, but do not make contact with it, except as the carbon ball completes the connection. In Fig. 2 the carbon ball is shown making contact between the top fuse and the U-shaped strip, which, when the cover is inserted in the porcelain back of the arrester, will receive metallic connection with the line terminal through the flat spring provided for that purpose in the channel at the right in the porcelain. A similar spring is in the left channel to connect the flat strip in the cover to the ground terminal.

The line and ground terminals and flat contact springs in the porcelain backs are well illustrated in Fig. 3. With the arrester thus assembled, it will be seen that only the top fuse has connection with the line terminal, and consequently is the only one that can be operated upon by a lightning discharge. The fuse may or may not be destroyed, depending upon the severity of the discharge and the condition of the line. If the line has a high potential and ground return, such as used on single trolley railway circuits, the static discharge will short-circuit the generator current at the discharge points and the fuse will be completely vaporized by the current following the discharge, which will permit the carbon ball to fall to the next fuse, bringing it into circuit automatically, ready to receive a second discharge. If a low potential metallic circuit is thus protected, one fuse may take care of several discharges, providing the circuit is perfectly free from grounds. If an accidental ground exists at the time of the discharge, the action will be the same as in the case of the railway circuit with the ground return. Or, if only a partial ground should exist at such time, the destruction of the fuse might not be complete; but the relative conductivity of the contact between the carbon ball and the small brass wire, as compared with the rest of the fuse, is so inferior in the former that the end of the wire supporting the ball is always the first to disappear, and is sure to allow the ball to drop and reset the arrester, even though the fuse should be only partially destroyed. The standard types of arrester are adapted to all currents up to 1,000 volts, whether having metallic or ground return circuits, but for higher potentials fuses with a slightly wider gap should be used.

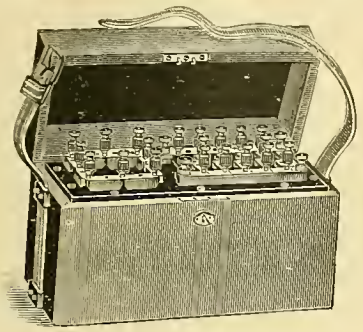
Having reduced, as far as possible, the resistance and impedance in the arrester and its ground connection, another important step toward the protection of the electrical apparatus will be accomplished by inserting a choke coil in the main circuit, so as to divert the lightning from it into the lightning arrester, and thence to the ground. For this purpose, the Ajax arrester is furnished with coils of various capacities to suit the carrying capacity of almost any circuit upon which it may be placed. For station use, the coil is necessarily of large dimensions and is usually placed at the back of the switchboard. The arrester may be placed on the front of the board and the connecting wires led through to it, or it may be put in any other place convenient for inspection. The dimensions of the arrester alone are 7 inches by 4½ inches by 2¼ inches.

The regular type of arrester used for protecting stationary motors or isolated plants is made with a 100 ampere coil, having coil and arrester mounted on a marble slab 7¾ inches by 11 inches by ⅞ inch. For electric cars or pole line use, the arrester is placed in an asbestos-lined iron box, to protect it from the weather or external injury.

Superintendent C. K. Minary of the Springfield, Ill., Electric Street Railway company is contemplating some extensive changes. It is now contemplated to run cars about every eight minutes by dividing the line into two separate divisions. A new curve is being put in at Fifth and Capital avenue, and the Seventh street run will be extended to Washington park. The lines running directly north and south and east and west will comprise one division, and the North Seventh, South Second, South Spring and South Eighth street cars will form another division. It is intended that these divisions will arrive seven and one-half minutes apart. Passengers who have missed a certain car can by walking two or three blocks catch another in seven and one-half minutes.

## Marshall's Combined Condenser and High Resistance Set.

The illustration shows a portable combined one-half microfarad condenser and 100,000 ohms resistance, the latter coil being divided into sections of 10,000, 20,000, 30,000 and 40,000 ohms each. The condenser is of the Marshall multiple series type divided into five sections of 1-10 microfarad each. By using the multiple series arrangement each section of the condenser can, if desired, be used independently of the others, and a wide range and gradation of capacities can be obtained. To facilitate this, each plug is provided with a binding post to which the wires leading to the discharge key and galvanometer can be attached. The



MARSHALL'S COMBINED CONDENSER AND HIGH RESISTANCE SET.

high resistance set is divided into four coils, and is likewise provided with plugs with binding posts. Each plug has a hole provided for its reception when not in use, so that there is no likelihood of its being laid aside and going astray. The great advantage claimed for this set is the combination of the condenser and the resistance in one box for portable testing purposes. These instruments are manufactured by William Marshall of New York, who also provides separate condensers.

## Conduit Electric Railways.

In the course of a paper in *Cassier's Magazine* bearing the above title, Joseph Sachs says:

The writer is of the firm belief that an open slot continuous wire conduit can be devised that will be commercially practical and efficient, and at a cost which will certainly compare favorably with the cable. The main difficulty with conduits that have previously been experimented with, appears to have been the extremely meager dimensions, bad location of the contact wires, and lack of proper drainage facilities and of protection of the wires from moisture. With a properly designed conduit, of ample dimensions and good drainage to start with, it would certainly appear to be within the powers of electrical engineers to so locate and insulate the wires as to keep them in proper working condition. The voltage or pressure used on the wires is, however, a most important item to be considered. In the various unsuccessful trials with the conduit it has been the practice to use very nearly the same pressure as that of the overhead system. This should be very much reduced. The conduit roads in actual operation are using only 300 volts or thereabouts. With even a lower pressure success can certainly be more readily obtained. With a direct current this could not very readily be accomplished without a large outlay in copper. It would appear, however, that some alternating current method of distribution could be devised which would be particularly fitted for this purpose, if a practical motor could be produced.

In concluding his paper the author makes these deductions:

It is peculiar that with all these various methods of solving the problem nothing really commercially practical has been attained except with the open conduit, and that only in one or two cases. Although, where the open continuous wire conduit is in operation, the conditions are quite favorable, it has really been the only method which has attained any practical success. The other systems that have been devised to meet the requirements of everyday street railway practice seem so far to have been entirely unsuccessful commercially on even the smallest scale. In fact, most of the modifications and elaborations of the continuous wire conduit appear to have more and greater inherent difficulties in the way of general success than exist in the simple open-slot conduit system. The excellent operation of the numerous cable roads, particularly those recently constructed, has certainly shown that an open-slot conduit, if properly built, can be maintained in good condition and drained so as to be practically clear and clean. It remains for the electrician to arrange and locate the wires within such a conduit.

The conduit should be large, well drained, patterned after first-class cable construction, and should be located midway between the tracks, and the top of the slot rail should be slightly above the top of the track. The wire should be located at the very highest possible point in the conduit, protected from exterior interference, and should be supported upon protected insulators in accessible pits or manholes at as great a distance apart as possible. An underbearing contact should be used, and the contact plow should be well protected from moisture and injury, and easily removable. The voltage should be as low as possible. With a good construction and a very low voltage one wire could be used with track return. As the voltage used will greatly affect the cost of construction by increasing the cost of copper for distribution, it must be proportioned so as to be within the allowable first cost.

In conclusion, it may be said that it is a question between the conduit electric railway and the cable road. The trolley will still reign supreme in its own field, but for cities where the overhead trolley is not wanted, the cable is today the only system which can be commercially operated to at least partial general satisfaction.

## The "Western Electrician" and the World's Fair.

[From Prof. Barrett's new book, "Electricity at the Columbian Exposition."]

The illustration shows the office and exhibit of the WESTERN ELECTRICIAN in the gallery of electricity building. This journal, the only weekly electrical newspaper in the West, early recognized the vast importance of the World's Fair to the electrical interests of the country, and from its location in Chicago and its position as the recognized exponent of that stirring activity in electrical development which distinguishes the central and western portion of the United States, it took a particular pride and pleasure in advocating and describing the extensive and varied electrical features of the exposition. Those who followed the profusely illustrated articles that appeared in the paper from week to week know how well this self-imposed task was executed. It is not too much to say that no other electrical journal equaled the WESTERN ELECTRICIAN in quality or quantity of World's Fair matter or in the number and excellence of accompanying illustrations. As early as 1890 the WESTERN ELECTRICIAN recorded the first movement for electrical representation. From that time until the close of the exhibition, and after, the electrical interests at the fair found in this journal their warmest champion and most accurate and minute chronicler.

The plans of electricity building were first made public by reproduced drawings published in the WESTERN ELECTRICIAN in the summer of 1891. This was soon followed by the first perspective view, which was drawn in the office of the paper from the architects' plans and afterward adopted by the World's Fair authorities as an official picture. The electrical construction work was carefully recorded as it progressed, and the articles on "Electricity at the World's Fair" were made a department of the paper, increasing in size, until, during the fair period, they constituted the leading feature of the journal. At the close of the exposition every electrical feature of importance had been fully described.

It was the WESTERN ELECTRICIAN which, on behalf of the electrical fraternity, led the opposition to the evening closing rule, which was eventually repealed, and the same journal was the first to publish the eagerly awaited list of electrical awards.

The distinctive World's Fair issue, published in the week ending May 6, 1893, and devoted entirely to World's Fair electrical matters, was undoubtedly one of the finest and

FALK TROLLEY WHEEL.

most richly illustrated numbers ever issued from the office of an American technical newspaper. It contained much valuable information, and elicited handsome compliments even from competitive electrical journals.

From its fortunate location the WESTERN ELECTRICIAN was the first electrical paper to greet the electrical men at the fair every week, and the coming of the blue-covered journal was eagerly awaited. The exhibit space was decorated with specimens of the fine illustrations for which the paper is noted, and these attracted much attention.

## Falk Trolley Wheel.

The accompanying illustration gives an excellent view of the Falk trolley wheel and harp, which is being offered to street railway people by the Central Electric company, Chicago. W. R. Garton, in charge of the street railway department of this company, considers this wheel a great improvement over other styles of trolleys using graphite or roller bearings. It is constructed with cone bearings which are so arranged that they automatically compensate or adjust themselves to the slight wear. The wheel is at all times kept in a perfectly true position so that it never wobbles, runs unevenly or rattles. An important feature is the "dope" chamber inside the wheel, where a supply of lubricant is carried sufficient for many miles of travel. No dripping of grease occurs. Everthing is made of the best grade of steel, and all removable parts are secured by steel pins so that nothing can work loose or change its adjustment. A recessed collar, which is a part of the cone-holder, encircles the hub of the wheel, so that if a cone should break, a very unlikely happening, the wheel cannot fall out or become displaced. The harp is so patterned that should the wheel jump the wire it will not catch or engage the span wires. The Central Electric company has in preparation a special circular of improved railway devices, which will be ready for distribution in a few days.

## Keuka Lightning.

There is a well defined suspicion that the young man who has written so many interesting bird and snake stories for the *Sun* has turned his attention to another field which will afford him still wider range for his peculiar style. This suspicion is partly based on the following story:

"Usually when lightning takes a notion to strike a fellow's house at night, it either gives him a pretty lively waking up or puts him to sleep forever," a man from Steuben county is reported to have remarked, "but we had some lightning up in the Lake Keuka region not long ago that went around dipping people's houses, and dipping them hard, but never disturbed a person in any of those houses, although the people in the houses that were not struck were not only awakened by the electrical freaks, but kept awake and in terror for hours by them.

"Nothing like this storm had ever been known before in the Lake Keuka region. It began about 11 o'clock at night, and kept right at it for nearly three straight hours. During that time there was not a second in which the thunder was not crashing or the lightning flashing. As many as three sharp flashes would precede a thunder-clap, which would follow with a crash that was appalling. For miles around the country was almost continually visible beneath the constant play of the lightning.

"Of all the persons who had gone to bed and asleep in the village of Hammondsport before the storm came up that night only two were not awakened by the fearful turmoil of the storm. Both of these were in houses that were struck by lightning almost as soon as the electrical bombardment began. One of them, a young woman, slept in a room next the roof and immediately under the spot where the lightning struck and demolished a chimney, but she did not wake up. The other house was also struck at the chimney, the bricks being scattered all over the roof. There was but one person in the house, and he did not know it had been struck by lighting until he discovered the wreckage of the chimney next morning.

"While people who had been awakened and kept awake by the storm, although their houses were not struck, thought it strange that any one could have slept through it all, especially when the noise of lightning-struck chimneys clattering about them was added to the commotion, no particular attention was given to the circumstance until reports from the storm in adjacent places began to come in.

"Across the lake in Wayne only two families knew nothing of the frightful disturbance until next morning, and the house of each family had been struck by lightning that night. At Mitchellville, three miles from Hammondsport, a barn was struck by lightning and set on fire. In trying to save the contents of the barn men found a tramp sound asleep in the haymow. He hadn't heard anything of the storm, although it had been raging for more than an hour before the barn was struck. Near Savona, at the Waite farm, the family got up in the morning after the storm and found both chimneys on their house gone and the bricks scattered about on the ground. The house had been struck by lightning twice during the night, and no one in the house woke up. Near Tyrone three farmhouses were struck, each one at a chimney, and the inmates of those houses were the only ones in the neighborhood who were not awakened by the storm.

"No fewer than fifteen houses were struck by lightning that night within a radius of five miles, and each one was struck at the chimney, four of them having both chimneys demolished; but in each house the inmates were soothed in the same way by the lightning, so that their slumbers were not disturbed.

"Besides the houses, nine barns were struck, and in dealing with those the lightning indulged in another queer freak. Not one house the lightning struck was set on fire or damaged beyond the demolishing of a chimney or two. The barns, in every instance, were fired by the lightning, and only two or three of them were saved."

## Improvement in Electric Railway Business.

According to the *Daily Financial News*, Pittsburg, there is marked improvement in the electric railway field. W. J. Clark of the street railway department of the General Electric company is quoted as saying: "The business of electric street railways is beginning to show renewed signs of life. The General Electric has orders in this department for 61 generators, eight of which are enormous machines. Small orders are again being received from the West and South, where business in this branch has been so dead for a year past that it has practically amounted to nothing. Special attention is being paid to the development of large surface motors for suburban traffic. Astonishing results have been achieved with the experiments in the Schenectady yard of the forty-ton locomotive recently constructed."

## BOOK TABLE.

ELECTRICITY AT THE COLUMBIAN EXPOSITION, INCLUDING AN ACCOUNT OF THE EXHIBITS. By J. P. Barrett. Chicago, 1894.

In this beautiful volume of over five hundred pages the author presents a description, so far as can be judged by an inspection as thorough as the limited time available will permit, of everything electrical at the World's Fair, and the book will consequently be of great value as a record of that very important and interesting portion of the exhibition which is fairly comprehended under the title. In arrangement the work is divided into chapters, each one devoted to some particular class of exhibits or electrical feature of the fair. Thus "Incandescent Lighting" is treated in one chapter, "Motors" in another, "Telephony" in a third, and so on. This is akin to the general classification scheme of the World's Fair itself and permits of studying by itself the showing made in any one class, although it necessarily involves the division of the descriptions of many of the large exhibits, so that each feature may be brought to notice in

the department to which it belongs and there compared with other exhibits of like character. The author dedicates the book "to the exhibitors in the department of electricity," and is very modest in his preface, saying of his work that it "nearly resembles a compilation." He thinks, and the entire electrical fraternity will agree with him, that a complete account of things electrical at the World's Fair should be preserved in book form, and it is this need that he has essayed to meet. The electrical features of the fair—on Midway and lagoon as well as in machinery hall and electricity building—are described in detail, and the seeker after information will find little, if anything, in this line neglected. The book is handsomely printed, illustrated and bound, and will form a fine addition to any library. Indeed, the beautiful pictures, of which there are a large number, form one of the most valuable features of the book, showing vividly the extent and importance of the electrical exhibits. An extract from the book, setting forth the relation of the WESTERN ELECTRICIAN to the World's Fair, is given in another place.

## CORRESPONDENCE.

### New York Notes.

NEW YORK, September 10.—On Thursday evening a party numbering two hundred, made up of members and friends of the New York Electrical society, assembled at Ambrose Park, South Brooklyn, on the invitation of the Edison Electric Illuminating company, to inspect the lighting plant by which the arena and buildings of the "Buffalo Bill Wild West Show" are illuminated and to be present at the evening performance. The trip was in line with the recent inspection of the Metropolitan telephone exchange and the Postal Telegraph company's new establishment, the idea being in each case to add to the fund of practical information of the members of this flourishing society. The visitors were greatly pleased at the excellence of the electric lighting effects shown in the enclosure. As at Chicago last summer, every detail of the elaborate programme was brought out as distinctly as by day. The arena was brightly illuminated by powerful focusing lamps with mirror reflectors, and the searchlight was directed on any object that it was desired to bring out into higher relief. The speed and accuracy of its manipulation were astonishing. An excellent illustration of the skill required was given when its rays were directed on the glass balls that were thrown up to serve as targets for the rifle ball of Col. Cody as he rode around the arena. Special seats were provided on the roof above the grand stand by the courtesy of Col. Cody, so that the operation of the searchlights could be followed throughout the performance. The courteous attentions of M. B. Bailey and W. S. Barstow of the Edison company were greatly appreciated. The lighting plant, which was installed by the company named, consists of two cross-compound 300 horse power Ball engines, four 100 kilowatt Edison generators and two 250 horse power Climax boilers. It furnishes current for 77 2,000 candle power Ward arc lamps, 808 16 candle power incandescent lamps, 50 4,000 candle power focusing lamps with mirror reflectors and three 10,000 candle power searchlights. The 2,000 candle power arc lamps and one-half of the incandescent lamps are used for lighting the grounds, and the balance of the installation is for lighting the arena. It was necessary to place the 4,000 candle power focusing lamps at an angle of about 45 degrees, and on this account the lamps were especially reconstructed by the Edison company. These lamps were originally of the old German Pieper type. On account of the quick manipulation necessary with the searchlights, hand-feeding lamps were used. This reduced the weight of the lamp so as to make possible the quick movements necessary in following glass balls or different objects of the arena. The arena occupies a space containing 104,600 square feet, and the curtain scene, located at the farther end of the horseshoe arena, contains 20,456 square feet. This large space is so lighted that the direct rays will not get into the eyes of the audience, actors or horses, and will not cast shadows. The plant is run as a regular annex station of the Edison company of Brooklyn, with M. B. Bailey in charge. The plant was erected in four weeks, and all foundations are carefully piled. The original contract with the show people was for six months, but this will probably be renewed for another six months. The current for the grounds is distributed directly from the station, and the current for the arena is distributed from a small building on the roof of the grand stand, in which is located the switchboard for controlling the arena lighting and also searchlights.

A short-circuit caused a "flash" in the power house of the Brooklyn City Railroad company at the foot of Division avenue, Williamsburg, on Wednesday night. The illumination blinded the men at work in the power house for a moment and lighted the streets for some distance. James Price, a dynamo tender, twenty-one years old, of No. 144 Twenty-seventh street, who had been cleaning a generator, was found on the floor unconscious and badly burned. He was removed to St. Peter's Hospital, where the physicians attended to his injuries.

Justice John J. Dupuy of East Rutherford, N. J., was called one evening last week to the home of George F. Stetler, in Park avenue, Rutherford, in front of which a big crowd had gathered. Stetler was using an ax with telling effect on a pole of the Paterson, Passaic and Rutherford Electric Railway company. As the justice reached the scene the pole tottered and the ax head flew off. Dupuy arrested Stetler, who had been drinking. The latter wanted to fight, and insisted that the pole was on his own property. Superintendent Ring of the railway company made a charge against Stetler, and he was lodged in the Rutherford jail. Stetler was formerly well-to-do, and had a large storehouse in West street, this city. He now has a grain and feed business in East Rutherford, and after cutting down the pole in front of his house proposed to chop down that in front of his store.

"Shaft No. 2," a new melodrama recently presented at the Columbus Theater, and now also running, I believe, in Chicago, is a noteworthy example of the prominence now accorded to electricity and electrical effects on the stage. The hero of the play, *Jim Rathburn*, is an electrician, and the first scene is in an electrical workshop. He has invented an improved rheostat, which proves to be the source of much trouble as the result of the machinations of the villain, *Hiram Ely*, who seeks to rob him of the fruit of his inventive skill. A storm is introduced with fine electrical effects, during which *Nelson*, a tool of *Ely*, is struck by lightning. *Rathburn* is discovered bending over the dead body of *Nelson*, who, by the way, had succeeded in destroying the rheostat, and is accused of murder. He is tried, convicted and sentenced to electrical execution. In the fourth act the hero is in desperate straits, as he is seen in the chair about to be executed by electricity. Just as the current is about to be turned on, however, a reprieve from the governor arrives, and the much-tried electrician is saved. *Ely*, lying at the point of death, confesses all, and of course the end is happy. This is probably the most completely "electrical" play that has yet been produced.

It is reported that the Metropolitan Traction company has definitely decided to introduce the conduit trolley system on all its lines, but it is difficult to obtain exact details of the change, some asserting that only new lines will be affected, the existing cable lines remaining as at present.

Lieut. G. N. Whistler, U. S. A., proposes that the force of the tides at Hell Gate be utilized by electrical transmission to supply all the power needed in New York and Brooklyn. The *Herald* has a glowing interview with him, in which he states that the plant would hardly cost $100,000,000 complete, but that it would save about half that amount every year. Lieut. Whistler considers it perfectly feasible to utilize the power of the tides by water wheels or other methods, and thus to operate electrical generators, storage batteries being used when the tides are not flowing. The project has created no great excitement, however. W. F. O.

### Milwaukee, Wis.

MILWAUKEE, September 8.—There is pending in the Milwaukee court a suit instituted by the Milwaukee Arc Light company to restrain the Badger Illuminating company from interferring with its wires. The arc light company had wires strung overhead, and it is claimed that Moritz Weil, a law clerk representing the Badger company, got a thirty days' lease of a building over which some of the wires passed, for the sole purpose of cutting down the wires, which he did. Mr. Weil is made a defendant in the case, and the arc light company asks for damages. The Circuit Court granted a temporary injunction.

People who have read about the Commandoer Water Power & Electric company, and the great things that it was going to do in the way of producing electricity for almost nothing by means of a new kind of water-wheel, will be interested in learning that the company has gone into the hands of a receiver. The receiver is Ernest E. Smythe, whose bond is in the sum of $2,000, with E. H. Jones and Ralph Chandler as sureties. The suit which resulted in the appointment of the receiver was instituted by George H. Ballhorn, by his guardian. Ballhorn had a small claim against the company.

At the next meeting of the Legislature, it is said, the street railway employes will introduce a bill to compel the street car companies to furnish vestibule cars in the winter as a protection to motormen.

The big engine built by the E. P. Allis company, which furnished a portion of the motive power for the electrical machinery at the World's Fair, is now in the Duluth flour mills at Milwaukee. The acquisition of the engine increased the capacity of the mills by 2,000 barrels a day.

The Milwaukee Street Railway company has been allowed to maintain its tracks on Sixth street, between Grand avenue and Clybourn street, as that bit of track, which is not used at present, may some day be part of a new line to the Soldiers' Home. Several odd bits of tracks in various parts of the city have been taken up. C.

## PERSONAL.

John P. Barrett, city electrician of Chicago, has returned from an extended eastern trip.

D. P. Perry, president of the Standard Electric company of Chicago, is confined to his home by a slight attack of illness contracted on his recent vacation.

A. A. Forman, an Iron Mountain, Mich., electrician, is in Chicago, purchasing an incandescent lighting plant for one of the large mines in the vicinity of his home.

Carl Grawinkel, the eminent German electrical engineer, died on July 6th at the age of forty-nine. Herr Grawinkel had particularly devoted himself to telegraphy and telephony, and was recognized as an authority in those branches.

Payson K. Andrews, formerly manager of the Chicago office of the J. G. Brill Car company, but more recently western manager of the American Car company, died suddenly on August 22d. Mr. Andrews was well known among street railway and electrical people as a successful salesman and a genial companion.

## NEW INCORPORATIONS.

Canton Light, Heat and Power company, Canton, O.; capital stock, $50,000; to furnish light, heat and power; William A. Lynch, Charles R. Miller, A. J. Underhill, L. C. Foltz, H. M. Lyman.

Camden Power & Light company, Camden, Ark.; capital stock, $10,000; to furnish electric light, heat and power; Henry C. Rose, Charles E. Vickers, William K. Ramsey and James Cummins.

Hempstead Traction company, Hempstead, Queens county, N. Y.; capital stock, $50,000; to construct a street surface road about four miles long; directors, Charles L. Barker, Abraham Barker, Miles C. Palmer, E. R. Tilton, T. H. Kilduff and William Kennelly of New York city; John S. Lawrence and D. L. Lewis of Hempstead and John F. Davis of Brooklyn.

Syracuse & East Side Railway company, Syracuse, N. Y.; capital stock, $200,000; to conduct a street surface road about ten miles long, the termini to be in the town of Dewitt and the city of Syracuse; directors, George B. Leonard, Frederick R Hazard, H. S. Holden, William Nottingham, David A. Batterson, Willis A. Holden and Jay B. Kline of Syracuse; John L. Kyne of East Syracuse, and Clifford D. Beebe of Dansville.

## ELECTRIC LIGHTING.

A. A. Tibbe of the Washington, Mo., electric light plant announces that he will soon add a 75 kilowatt alternator to his outfit.

The building for the electric light plant, at Albert Lea, Minn., to take the place of the one burned the morning of July 4th, is about completed. The engine and boiler are in position, and it is expected the plant will be ready to start up this week.

The work of fitting the figure of the Goddess of Liberty on the dome of the capitol at Washington with electric lights, which was pronounced impossible, has been finally done. An effort was made during the Knights Templar conclave and the Grand Army encampment of 1892, but it was abandoned as being too hazardous. Mr. Ports, an assistant to the chief electrician of the capitol, accomplished the feat by means of a ladder held by four men on the top landing of the dome. The figure was illuminated in honor of the visiting Knights of Pythias.

The Woonsocket, R. I., Electric Light & Power company recently was granted a franchise by the Lincoln Town Council to string wires to Manville. There was opposition to the company, as there were efforts to organize an electric light company in Manville. However, the franchise was granted, and in order to head off further opposition the company began at once stringing wires. The work progressed until the men were ordered by the town sergeant to stop work under a threat of arrest. The men were at once set to work on another part of the line.

The Chicago Edison company has filed two suits in the United States District Court against the Superior Light, Heat and Power company of Chicago, operating a plant for incandescent and arc lighting in the basement of 213 and 215 State street. Emil W. Ritter, president, and Emil L. Oppermann, secretary, are made defendants with the company. The suits are for infringement of the Edison patents. The bill setting forth the issue avers that the defendant company is using the Edison patents, the Chicago rights to use which have been vested solely in the Chicago Edison company.

## ELECTRIC RAILWAYS.

The Rutland, Vt., Street Electric Railway company has made a contract with the Rutland Electric Light company for motive power.

Contracts have been let by the Lowell, Lawrence & Haverhill, Mass., Street Railway company which call for the completion of an electric road from Lawrence to Lowell within sixty days. The work of construction will begin from the terminus of the Glen Forest division.

Three electrical storms visited Baltimore on September 8th. The last one, about eight o'clock in the evening, was the severest of the summer. Dynamos were burned out and all the trolley street car lines were tied. Trees in the parks were split and burned and several barns in the county were fired.

An effort is to be made to build another street railroad in Cleveland, O. J. S. M. Hill of No. 606 Euclid avenue is the prime mover in the project. The company is to be known as the Forest City Electric Railway company, and the road is to start from Water street on Lake and follow that street to Alabama, and thence to take a northerly direction to Hamilton, out Hamilton to Marquette, thence across private property to Broad avenue, which will bring

passengers to Gordon park. Thence the road is to pass along easterly across Doan street to Lake View avenue to Superior street and out Superior to the junction with Euclid avenue, a distance of about seven miles. A system of transfers is to be arranged with the Big and Little Consolidated, so that passengers can go anywhere for one fare.

The Schuylkill Real Estate Title Insurance & Trust company of Pottsville, Pa., has entered against the Schuylkill Electric Railway company an action in assumpsit in the prothonotary's office. The defendant company, it is said, has defaulted in interest due the trust company, the amount being between $3,000 and $4,000. The declaration by the plaintiff has not been filed, and therefore the exact figures cannot be given. This money represents interest due the trust company for money loaned the company when the trust company agreed to put $95,000 worth of the railway bonds on the market. The Reading Railroad company is a large stockholder in the trolley road, and it was only recently that the road was transferred to a syndicate of Philadelphians. This syndicate was to assume all this indebtedness, but has failed to pay the first interest due.

Contracts have just been awarded for the construction of the second link in an electric railroad chain from Baltimore to Gettysburg. A line will be built immediately from Pikesville to Reistertown and Emery Grove, the camp-meeting resort. The Pikesville, Emery Grove & Reistertown Electric Railroad company was organized last November, but has just begun active operations. New York and Philadelphia capitalists are large holders of the bonds, and it is believed that the Widener-Elkins syndicate holds an interest in it. The owners of the Gettysburg electric railroad, which now runs southeast from Gettysburg several miles toward Baltimore, will extend their line southeast through Littlestown, Pa., to Union Mills, Md. These lines will give an electric route from Baltimore to Gettysburg fifty miles long, as against seventy-two miles by the existing railroad route.

A contract has been awarded to the Lancaster Railway Construction company by the Pennsylvania Traction company for building forty-three miles of electric railway in Lancaster county. The lines will run from Lancaster to Manheim, Lancaster to Mechanicsburg, New Holland, Blue Ball and Terre Hill, with an eight mile branch from Mechanicsburg to Ephrata. The specifications call for Pennsylvania railroad standard construction, including switch and signal system. The overhead construction and all equipment will be of the highest grade, and must be completed, ready for service, within ninety days. The Lancaster Railway Construction company is a chartered corporation with ample capital. The officers are Henry Baumgardner, president; Michael Reilly, vice-president; F. H. Steacy, secretary; J. E. Hubley, treasurer; H. E. Crilly, superintendent of construction.

## MISCELLANEOUS.

Two passenger trains on the Chesapeake & Ohio railway have been provided with electric tail lights by the chief electrician, W. S. Greene. A parlor and observation car is attached to the train that leaves Cincinnati about noon each day, the car being dropped at Hinton and returning to Cincinnati next day. The two observation cars that are required to give this service are lighted by incandescent lamps. Storage batteries furnish the current. Wires are run to the tail light brackets, and one connection is made through the bracket and the other through the lamp base, which fits in the base of the regular lamp casing, replacing the cup which usually holds the oil and wick. The two cars are also provided in the observation end with electric fans.

A recently invented novelty in electrical appliances consists of a window sash operating device. Briefly described it consists of a switch having two keys, one of which operates the upper sash, while the other key controls the bottom sash. By turning the keys to the right the sashes are raised, while a turn in the opposite direction lowers them. Other mechanism in addition to the switch employed is required to complete the apparatus, but as this is to a large extent out of the way and not to be tampered with by the uninitiated a description of it is unnecessary. However, it is simple and can be readily applied to any window without much trouble and without remodeling the frame. The invention is particularly convenient in houses supplied with fly-screen blinds, curtains and inside shutters. By means of a switch properly placed on the lower floor of a house, all the windows can be closed at once in case of sudden storms, etc., without a visit to each window. This feature makes it particularly adapted for schools, halls, public and office buildings, especially churches, as the minister can have his pulpit provided with a suitable hidden switch board, and can, when desired, let in fresh air. The janitor of a modern village hall can introduce a new pastime if the windows of the building are supplied with this device, for by properly locating the switches at one central point he can, during the festival season, amuse himself and those whose money has contributed to the success of the entertainment by trapping all small boys and other unauthorized persons who, with irrepressible audacity, insert their heads or bodies through the windows. A simple thermostat placed in circuit with the window mechanism will automatically open or close the upper sash to regulate the temperature of a room.

## TRADE NEWS.

Green's patent fuel economizer, manufactured by the Fuel Economizer company of Matteawan, N. Y., has been awarded a diploma of honor at the Antwerp Exposition.

The Washington low-tension arc lamps for alternating circuits, manufactured by the Washington Electric company, 201–207 South Canal street, Chicago, continues to meet with favor among users. Last week quite a few orders were received.

"Hints to Engineers Operating Small Electric Light Plants" is the title of a little pamphlet just published by the Correspondence School of Technology of Cleveland, O. E. P. Roberts and W. B. Stewart are the authors, and many useful facts are compressed in a small compass.

The Interior Conduit & Insulation company of 44 Broad street, New York, has just issued an attractive catalogue of the Lundell dynamos and motors. The pamphlet is well printed and handsomely illustrated, and describes in detail the machinery of this type as well as directly connected outfits, starting boxes and all needful supplies.

C. B. Case of Milwaukee, Wis., has taken the agency of the Electric Storage Battery company's chloride accumulator for Milwaukee and southern Wisconsin. Mr. Case has had an extensive experience in the introduction of gas engines, and he looks for the extensive application of the storage battery in conjunction with the gas engine for isolated residence lighting and power.

The contract for the completed work for the West End Street Railway company's subway system at Boston has been awarded to the National Conduit Manufacturing company. This contract will amount to about $60,000. The National Conduit company feels much elated over this, as it secured the contract in direct competition with every style of conduit system that is in use to-day.

The well-known electrical system of temperature regulation exploited by the Johnson Electric Service company is described and illustrated in a recent pamphlet. Experience has demonstrated this to be a very efficient and reliable system, and it is highly thought of in Chicago, where it is in use in many of the finest office buildings. The company is represented in Detroit at 39 Clifford street by William B. Roberts, formerly general manager of the Rockford Electric Manufacturing company.

The Mason Electric company, Chicago, announces the receipt of a large order covering the overhead material needed on the Chicago City Railway company's large extensions. The contract calls for the Medbery insulating material, which has had such an enviable record as to lead to its adoption by a large number of the leading traction companies in the East. The Mason Electric company is the agent for the West and South for this high grade material and is meeting with great success in placing it in its territory.

Prof. W. A. Anthony and Edward P. Thompson have associated themselves in business, with an office at 5 Beekman street, New York, as experts in electrical engineering and electrical patent matters. Prof. Anthony will take charge of the engineering work and Mr. Thompson will superintend the procuring of patents. Prof. Anthony is well known to the electrical fraternity. He was professor in physics at Cornell from 1872 to 1887, and since then he has been a consulting electrical engineer of recognized authority and high standing.

S. W. Rushmore of Jersey City has recently placed on the market a complete line of search lamps for all classes of service. The new lamps are made to suit all the requirements of land and sea, in sizes from 200 amperes to a small light taking but five amperes for yachts and signaling purposes. All sizes are made with lens mirror reflectors, but the smaller sizes are also made with parabolic reflectors where a cheaper lamp is desired and a perfectly concentrated beam of light is not necessary. Mr. Rushmore has had a wide experience in designing and building search lamps, hundreds of which are now in use in all parts of the world. For some time he has been designing and making the apparatus of the Scott Electrical Manufacturing company.

The S. Freeman & Sons Manufacturing company of Racine, Wis., manufacturer of steel boilers, is one of the fortunate concerns that have not felt the effects of the business depression. The shops have been running ten hours a day since March, with a full force of over 200 employes. Business is brisk, and the company is considering the advisability of doubling the number of men and running night and day. Work on a new boiler shop, 250 by 105 feet, is about to be commenced. This factory will have a separate power equipment and will be supplied with a fifty-foot overhead traveling electric crane. It will be located on Hamilton street, and, with the new machinery, will cost about $25,000.

The Colburn generators and motors are described in a new catalogue issued by the Colburn Electric Manufacturing company of Fitchburg, Mass. The company was established in 1881, and the machines are the result of much study and experiment. But one magnet coil is used, and the short magnetic circuit is claimed as an advantage. The commutator is of extra large size, and is said to be absolutely non-sparking. Constant potential machines are made in capacities ranging from ¼ to 64 kilowatts. A specialty is made of electro-depositing dynamos, including the unique bicycle power plating dynamo, and the company also manufactures all other apparatus needed for a complete plating, electrotyping or refining establishment.

Bradley & Co., 7 Stone street, Rochester, N. Y., have placed on the market the universal telephone switch hook of which they are making a specialty. This device is highly recommended by users and by telephone experts, and not a few of the latter have recommended its introduction in exchange service. It is claimed that this device in no way infringes the patents held by the Bell Telephone company. It will operate with any style, size or weight of receiver. The switch connection can be arranged so that it will operate on any system of wiring. It is so compact and simple that it can be fitted in a moment to any style of magneto bell. When not in use it properly locks the telephone, thus avoiding any possible chance for the telephone or cord to become broken or disarranged.

The United States Projectile company of Brooklyn, N. Y., manufacturer of the hot-pressed motor pinion, which has met with success, has, it is claimed, perfected an improvement in trolley poles which materially reduces the weight as compared with the ordinary pole and will give a stronger rod. The process is similiar to that used by the company in manufacturing bicycle tubing, and the material is the same. The pole is started from a solid block of steel 3¾ inches in diameter and 7 inches long, and is gradually drawn out until it is the standard length; that is, 12 to 13 feet, and is then tapered, making a neat looking pole. A fine grade of Swedish steel is employed, and the pole by this process is said to be 25 per cent. lighter than the common one, and stronger. By relieving much of the tension on the wire it will lengthen its life. About 200 of these poles have been used on the Brooklyn Heights railroad during the last six months, and that company reports that only one of that number has been broken beyond repair.

## BUSINESS.

The new catalogue and price-list of the Samson Cordage Works of Boston is out. This company manufactures cord of all kinds, including arc lamp and trolley cord.

The Bristol company of Waterbury, Conn., now covers a wide field in the line of recording instruments for pressure, temperature and electricity, as is shown by the latest catalogue. In electricity the company has a fine line of recording voltmeters, of all ranges for both direct and alternating current, as well as recording ammeters and wattmeters. In about three weeks the company will move into its new factory, 50 by 150 feet, which has been built to accommodate increasing business.

The Electric Appliance company, Chicago, wishes to warn its customers against imitations of the Packard lamp which are being offered to the trade with the statement that they are Packard lamps or just the same as Packard lamps but without the Packard label. The Packard company and the Electric Appliance company wish to state positively that unless the lamps are purchased from their authorized agents and bear the Packard trade-mark label, they are not the genuine article. It is also noted that the new Packard transformer, type "G," with the combination fuse block for changing the ratio of the windings to make the transformer either 50 and 52 volts or 100 and 104 volts secondary, is pleasing the trade greatly and seems to have the most satisfactory arrangement so far devised for this purpose.

The Mather Electric company of Manchester, Conn., reports the shipment last week of two 1,000 light, ring type dynamos, with complete switchboard, for the new Davidson Theater at Milwaukee, Wis. This order was secured through J. Holt Gates of Chicago, the western contractor of the Mather company. On a recent test made by a prospective purchaser on a three horse power Manchester motor, built by this company, the phenomenal efficiency of 92 per cent. was obtained. Manufacturers of electric motors as a rule claim from 80 to 85 per cent. efficiency on their respective motors, and the Mather Electric company determined to bend every effort toward turning out a motor that would astonish the electrical fraternity. Several large concerns have recently equipped their factories with Mather apparatus.

President W. O. Meissner of the Washington Electric company, 205 South Canal street, Chicago, has just returned from a successful business trip to Pittsburg, where he succeeded in closing up a deal with the Department of Public Works of that city for fifteen of the Washington company's 8,000 candle power Meissner focusing lamps. These lamps will be used in the Schenley Park electric fountains at Pittsburg. Mr. Meissner is naturally much elated over the rapidly growing favor with which his specialties are being received. He will probably return to Pittsburg to be present at the first public test of the fountains. The Washington company is also receiving a number of orders for its improved stage dimmers, which are built on the same principle as the Washington imperial rheostat. These dimmers are looked upon with favor by theatrical men on account of their freedom from noise when used with alternating currents.

The following is a list of recent sales made by the Chas. E. Gregory company, Chicago: Schnider company, Garner, Ia., one 60 light United States plant; Rud. Lafferty, Chicago, one 1 horse power C & C motor; Garner-Morgan Electric company, Chicago, one 10 horse power Detroit motor; J. W. Alber, Chicago, one 10 horse power Crocker-Wheeler motor; Crane Elevator company, Chicago, one 25 kilowatt Westinghouse motor and one Crocker-Wheeler motor; C. C. Travis, Lacon, Ill., one 100 light Excelsior dynamo; Wilson & Jackson, Chicago, one 8 light arc plant and one 10 horse power engine; C. R. Claghorn, Connemaugh, Pa., one 5 horse power Crocker-Wheeler motor; R. Roach, Chicago, one 210 light Edison dynamo; Garibaldi & Cuneo, Chicago, one 1 horse power C & C motor; Seeger, Guernsey & Co., city of Mexico, Mexico, one 50 light United States dynamo, one 100 light United States dynamo, and one 1 horse power Crocker-Wheeler motor; Geo. Cutter, Chicago, one 1 horse power Crocker-Wheeler motor, one 450 light dynamo; Pontiac L. H. & P. company, Pontiac Ill., one ½ horse power motor; Jorden Show Printing company, Chicago, one 10 horse power Edison motor; Capt. E. E. Napier, steamer Mactawa, one 5 light arc plant; Pamondon Manufacturing company, Chicago, one 60 light United States plant; C. Shotte, Chicago, one 210 light Edison dynamo; Hatch Cutlery company, Buchanan, Mich., one 25 kilowatt Edison motor; University of Colorado, Boulder, Col., one 100 light United States plant; Northwest Fixture company, Seattle, Wash., one 5 horse power Sprague motor; Tuscaloosa G. & E. L. company, Tuscaloosa, Ala., one 100 light United States dynamo; Champaign & Urban Electric Railway company, Champaign, Ill., one 10 horse power Thomson-Houston motor; Tappan Steam Pump company, Chicago, one 1 horse power Crocker-Wheeler motor; Windermere Hotel, Chicago, one 3 horse power Sprague motor; D. S. Huff, Morris, Ill., one 50 light United States dynamo; Charleston Thomson-Houston Electric company, Charleston, Ill., one 1 horse power Crocker-Wheeler; receivers of the Pennsylvania Steel company, Steelton, Pa., sixteen standard lamps; Kuh, Nathan & Fischer, two Ward lamps; Elmer P. Morris, Indianapolis, Ind., six Ward lamps; Robins Electric company, Pittsburg, Pa., four Edison arc lamps.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

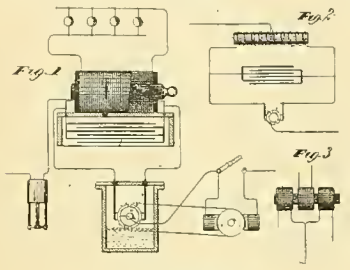
*Issued September 4. 1894.*

525,332. Electric Switch. George F. Card, Covington, Ky. Application filed April 14, 1894.

A combined switch and blow out is provided, which is controlled by means independent of electric current. It has been found in practice that when a line carrying a current of high potential or high amperage is broken by means of a switch or cut-out an electric arc follows the disengaging contact and burns the switch out.

525,336. Controlling Device for Electric Railway Cars. William H. Conrad, Lebanon, Pa. Application filed January 8, 1894.

The device affords means for releasing the brake and turning on the current, or turning off the current and applying the brake. In either event the current of electricity and the brake cannot be on at the same time, while the current and the brake are in full control of the motorman so that he can with one hand operate both. The special feature of improvement comprises means for preventing the car when on an inclined part of the roadway starting back during the time which elapses between the releasing of the brake and the application of the current of electricity to start the car.




NO. 525,369.

525,353. Dynamo-electric Machine. James F. McElroy, Albany, N. Y. Application filed January 10, 1891.

Claim 1 reads as follows:
In a dynamo-electric machine the combination of an annular frame, a series of electro-magnets secured within said frame and provided with radially inward extending cores placed at equal distances apart, a magnetizing circuit connecting the coils of the alternate magnets and forming alternate positive and negative field magnets, a genererating circuit connecting the coils of the intermediate magnets and a series of magnetically insulated armatures mounted upon a revolving shaft, and each provided with two radially extending poles corresponding in size with the poles of the electro-magnets and adapted to magnetically connect the poles of two adjacent magnets simultaneously to all the armatures.

525,354. Electrical Current Director. James F. McElroy, Albany, N. Y. Application filed July 1, 1891.

This is a method of converting or directing alternating currents so that the current flows through the two conductors of a main circuit, and consists in connecting both poles of the alternating generator to each main conductor or each terminal of the main circuit by means of branch conductors and alternately producing in these branch conductors electrical resistances synchronous with the current phases of the generator, whereby the current waves of like sign will always be diverted over the same main conductors in the same direction.

525,369. Electric Lighting System and Apparatus. Elihu Thomson, Lynn, Mass. Application filed February 21, 1887.

This arrangement provides for the operation of incandescent and arc lights upon the same general circuit without danger of interruption to the arc lights from the failure of incandescent lamps and without the employment of special cut-outs or protective switches in connection with the incandescent lamps. It is frequently desirable in electric lighting where arc lamps are run in series on a high potential line of considerable length to operate incandescent lamps at one or more points on the same circuit This has been accomplished by including the incandescent lamps in the direct circuit with the arc lights, the circuit being split into a number of branches to accommodate a number of incandescent lamps of high resistance. In such a system it is necessary to combine with the incandescent lamp proper automatic switches, so that in case of rupture or failure in any of the incandescent lamps the circuit for the arc lamps shall not be interrupted or seriously affected in its resistance This system is liable to the two-fold objection that it requires the use of complicated and expensive switching appliances, and that the switching appliances themselves may fail to act properly, in which case the arc lights may go out or may be deranged. In this arrangement the use of switches is entirely dispensed with The arc lamps are included in series with one another on a main or principal circuit carrying a current of high electromotive force proper for operating arc lamps in series and incandescent lamps supplied with current inductively transferred from the main by the action of an induction coil whose primary is included in the main circuit while its secondary is connected to the circuit of the incandescent lamps. The illustrations give an excellent general idea of the system, Fig. 1 being a diagram of the system, while Fig. 2 represents diagrammatically an arrangement of circuits where a local circuit changer is employed with the induction coil for setting up changes of magnetic condition which shall produce the secondary or induced currents. Fig 3 illustrates a modified disposition of the primary and secondary coils.

525,390. Steam Turbine Dynamo. James F. McElroy, Albany, N. Y. Application filed December 19, 1893.

Claim 3 follows:
In a steam turbine dynamo the combination of an electromagnet forming the field of force of a dynamo, a frame supporting the same on its vertical axis, a steam turbine provided with a casing supported on said frame below the magnet and provided with an annular steam ring, a shaft vertically supported in bearings in the top and bottom of the casing in axial line with the magnet, a steam wheel flexibly carried by the shaft, an armature shaft united with the shaft of the steam wheel, a bearing for the upper end of said armature shaft and an armature flexibly carried by said armature shaft.

525,394. Controller for Electric or Other Motors. Elmer A. Sperry, Cleveland, O. Application filed July 21, 1894.

This device is intended especially for electric cars in applying the brake or using the motor to brake the car, and interlocking devices between operating handles which are designed to perform different functions in connection with the motor or operation of the connected mechanism; for instance, the motor handle and the braking handle of motor-driven cars Motormen not being experts, often apply the motive power to cars while the brake is yet active, and also attempt to apply the brake while the motor is still acting. The invention is designed to obviate this by arrangement for dis-simultaneous operation, so that one cannot be operated until the other is thrown off.

525,395. System and Apparatus for Control of Electric Motors. Elmer A. Sperry, Cleveland, O. Application filed July 24, 1894.

In electric machines where the inducing capacity at start greatly exceeds the normal, or where such capacity is reduced for increasing speed, it has been found that for the best results at the time of changing the inducing capacity certain changes should be made in the position of the commutator brushes, owing, for instance, to the shifting of the so-called neutral point upon the commutator. The invention relates to an automatic method of securing this change, and when the motor is running in either direction. It has been found that when the machine is used as a motor a large economy in current consumption can be effected in starting; also, that during excessive loads or during the time of heavy acceleration it is not desirable to alter the inductive capacity or lower the capacity of the motor for generating counter-electromotive force at constant speed, and certain automatic devices are introduced to prevent the alteration, except when the conditions will permit; for instance, when the motor is used to propel a car on a level track with not too high degree of acceleration.

525,400. Electric Lock. Frederick Apitz, Lockport, Ill. Application filed May 31, 1894.

The lock bolt is prevented from being moved backward by the key until released by means of the electric apparatus.

525,437. Electric Cigar Lighter. A. C. Albertsen, Chicago, Ill. Application filed November 29, 1893.

No flame is used to light the cigar, but a sufficient and uniform current of electricity is supplied to render an exposed platinum wire or foil incandescent.

525,445. System of Electrical Distribution. Thomas C. Coykendall, Rondout, N. Y. Application filed January, 4, 1894.

The invention consists in providing a relatively high resistance path to line, preferably in the form of a shunt around the terminals of the break-switch of such systems in order to maintain a constant path to line and providing the same with a suitable indicator for the current.

525,446. System of Electrical Distribution. Thomas C. Coykendall, Rondout, N. Y. Application filed January 18, 1894.

An automatic device is provided for returning the break switch in a system of electrical distribution when it has been opened by a ground or other fault on the line, and to maintain it open until the ground has been broken or the fault remedied, so that the machine may be safely thrown in to feed the line.

525,447. Alternating Current Motor. Olof Dahl, Paterson, N. J. Application filed December 8, 1892.

The first claim reads:
The method of operating synchronous alternating current electric motors, which consists in first passing the alternating current through a distributed area within an active magnetic field for starting, and subsequently passing said current through a concentrated area, independent of the distributed area, for synchronism

525,480. Electric Railway System. Francis B. Badt, Chicago, Ill. Application filed October 22, 1892.

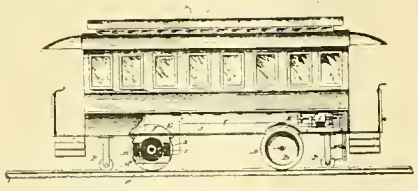
In the accompanying illustration *A A* are rails upon which the car wheels *B B* run; *C* is the body of the car, having the axle *D* suitably associated with a direct current motor, having the field magnets *E E*, armature *F*, commutator *G* and brushes *H H*, from which lead the conductors *J*. These conductors lead to brushes *K K* on the commutator at one end of the motor transformer *L*, which is provided with three brushes *M M* on its other end to receive multiphase current from the three local conductors *N N*, which lead from the trolleys *P P* on the three insulated rails *R R* on the track bed between the traction rails. Assuming the car provided substantially as shown with the devices herein illustrated, there would be by the proper manipulation of the trolleys multiphase currents delivered over a three-wire system to the car, and these multiphase currents would be led to the motor transformer on the car at any convenient point A direct current would then be delivered by the motor transformer to the direct current motor, thus operating it and driving the car.

525,490. Heat Regulator for Incubators. Huber R. Davis, Cardington, O. Application filed August 31, 1893.

This device may be applied to any form of incubator which employs an ordinary lamp to supply the heat, and may be relied upon to regulate the temperature to any desired degree.

525,491. Electric Battery. Louis Drescher, New York, N. Y. Application filed March 23, 1894.

The cell is provided with an ante-chamber or vestibule through which the gases may find easy escape, but which will retain all the liquid or semi-liquid which may ooze through the inner vent and the salts which may be formed about it.



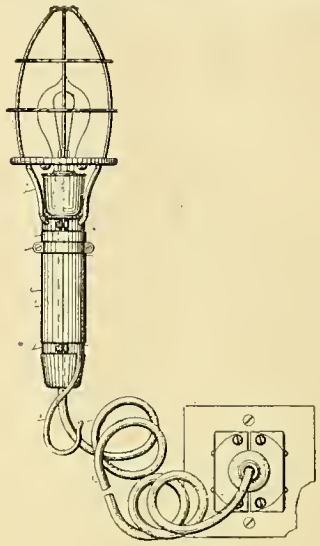
NO. 525,480.

525,505. Electro-magnetic Car Brake. Robert T. Murray and Charles M. Allen, San Francisco, Cal. Application filed October 24, 1892.

The principal feature of this invention is to provide a brake in which the electro-magnet is attracted with any desired degree of force to the rails over which the car is passing, whereby the friction of the brake upon the rail may be increased to any desired degree independent of the weight of the car. The device is also useful in the case of electric cars when climbing steep grades to increase the tractile force of the wheels by the employment of a strong electro-magnet, the armature of which is retained a short distance above the rail, but near enough so that the attraction will act to hold the wheels more firmly in contact with the rails than could be effected by the weight of the car alone.

525,523. Electro-magnetic Tractile Device. Charles M. Allen, San Francisco, Cal. Application filed August 22, 1893.

The tractile force of the wheels of a vehicle is temporarily increased, so that they will be prevented from slipping when power is applied to start the motor or train, or to climb steep grades, or under any condition in which it is desirable to increase the tractile power. This result is obtained by the use of powerful electro-magnets so arranged with relation to the rails of the track over which the car passes that when the magnets are energized the structure upon which they are mounted will be attracted toward the rails with a power dependent upon the magnetic strength developed, and this attraction is equivalent to the addition of a greater weight to the vehicle, whereby the adhesion of the wheels to the rails is correspondingly increased.



NO. 525,564.

525,539. Conduit Electric Railway System. Oscar A. Enholm, New York, N. Y. Application filed April 17, 1894.

A main conductor is connected with a series of separate or insulated sections that are successively brought into electrical connection with the main conductor or circuit by the passage of a car or motor.

525,548. Frozen Water Alarm. W. Humberstone, London, Eng. Application filed May 14, 1894.

Claim 1 is as follows:
The combination with the cylinder containing the flexible diaphragm or disk, of the lever pivoted above said disk, means connecting said lever with said disk, a pivoted plate, a catch adapted to hold said plate in a position to conceal a warning notice, and means intermediate said lever and catch whereby when the lever is raised the catch is moved so as to release said plate and disclose a warning notice.

525,563. Electrical Cut-out. A. Rockoff, New York, N. Y. Application filed May 10, 1893.

The device is intended to be used in connection with a portable electric lamp.

525,564. Handpiece for Electric Lamps. August Rockoff, New York, N. Y. Application filed May 10, 1894.

The illustration fully explains the application of this device, the principal claim for which is that it comprises three sections, two of which are semi-cylindrical, and are united together and provided with a socket at one end. The third constitutes a socket for an electric lamp, and engages with the socket of the first mentioned two sections. The wires within the handpiece and the joints of the handpiece are protected with cement

525,584. Railway Signaling by Means of Detonating or Explosive Signals. Herbert Brocklehurst, London, Eng. Application filed November 3, 1893.

Detonating or explosive signals are exploded by causing the train or a suitable device actuated by the train when it reaches a given part of the track to close or complete an electric circuit which includes platinum or other wires within a cartridge or detonating signal, whereby the electric current explodes the cartridge or signal

525,649. District Telegraph Call. William H. Garven, Portland, Ore. Application filed February 19, 1894.

The system is designed to show on the face of the receiving box in a pictorial way the thing called for. The call goes into the central office on two different circuits, and is printed on tapes by two different registers, and the boy also notifies the person who sent the call that it has been received and is being attended to.

525,653. Rosette for Electric Light Wires. Charles N. Hammond, Boston, Mass. Application filed January 15, 1894.

The first claim reads:
A rosette having an internal chamber, a back or base extending continuously across and closing the said chamber, a central hole through which the lamp-cord passes to the said internal chamber, side holes perforating the sides of the rosette, and through which the ends of the lamp-cord may extend for connection with the feed wires, strips loosely fitting the said side holes, and binders applied to the outer ends of said strips and entering loosely cavities in the body of the rosette to check endwise movement of the strips in the said holes.

525,670. Underground Conduit. Alexander Segade and Denis J. O. Regan, Detroit, Mich. Application filed March 6, 1894.

The principal features of this invention are the construction of the sections of an outer metallic casing containing a series of ducts, and an insulating material around the ducts formed of compacted wood or paper pulp; also in the construction of the joint between the adjoining sections and in the construction of the service box.

525,598. Overhead Switch for Trolley Wires. Hugh M. Greenwood, Brooklyn, N. Y. Application filed December 1, 1893.

This invention can be used either for a right or left angle branch. Sparking and the jumping of the trolley from one arm to another will be avoided, and the danger of escape of the trolley greatly reduced.

Western Electrician.

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## Power House of the St. Louis Union Station.

About two years ago the Terminal Railroad association of St. Louis decided to build a new union depot. The site selected covers an area 820 by 606 feet, about 11 acres, fronting on Market street between Eighteenth and Twentieth and extending south to Clark avenue. The express buildings and connecting yards cover an additional area of 21 acres extending southward from Clark avenue to the main yards of the association at Poplar street. The Terminal Railroad association is owned and controlled by the B. & O., the Big Four, L. & N., Mo. Pac., St. L., Ill. & S. and Wabash Railroad companies, and is the lessee of the St. Louis Bridge, Tunnel Railroad, St. Louis Union Station and terminals in St. Louis and East St. Louis.

The new union station, express buildings, power house, yards and real estate cost $6,500,000. It is said to be the largest passenger station in the world. The main building cost $900,000, the train shed $750,000 and the real estate $1,000,000.

The main building has a frontage of 606 feet on Market street and a depth of 80 feet. It is built of Bedford stone in the Romanesque style of architecture. Near the east end is a tower 264 feet high. There are two porte cocheres, one at the main entrance and one at the Eighteenth street entrance to the Midway. There is also a carriageway under the western part of the building. The extreme west end of the building, which is to be a hotel, is not yet finished.

The interior of the building is finished in hardwood, tiling and marble. The most notable feature of the building is the grand central hall, 74 by 120 feet and 60 feet high. The floor is mosaic work in marble. The ceiling is barrel-vaulted in form and the decoration rich in colors and design. To the west of the grand hall is the gentlemen's waiting room and restaurant, and to the east is the ladies' waiting room. On the ground floor is located the general waiting room, ticket and other offices. The upper floors are used for the offices of the various departments of the Terminal Railroad association. There are two Hale electric elevators in this portion of the building.

Between the main building and the train-shed is the Midway, 50 feet wide, 34 feet high, and extending the full length of the main building. The Midway is well lighted—one half of its roof being of glass—and is paved throughout with granitoid.

The building is heated and ventilated by three systems, the Plenham system, direct radiation, and direct indirect. The heating apparatus for the entire station—that is, the main building, the Midway, train-shed, coach connections and express buildings—has a capacity to supply 44,500 square feet of radiating surface. Fresh air for ventilation is taken from the top of the tower. Two rotary fans run by electric motors at the base of the tower furnish the supply of air.

The train-shed covers a space 630 by 606 feet, and is built entirely of iron and glass. The entire area is covered by a single roof. Thirty tracks are laid in it. Each track has an average length of 630 feet under the shed. The baggage room, two stories in height, and 33 by 300 feet, is located along the Twentieth street side of the train-shed.

The new union station was finished and opened for traffic September 2d. The power house has been finished and in operation some three months, supplying light for the old depot.

### THE POWER HOUSE.

The power house is located south of the train shed in the Y or triangular space between the east and west connecting tracks of the station and the main yards of the Terminal Railroad association. The building is a substantial brick structure with Bedford stone trimmings, 134 feet 4 inches by 61 feet 2¾ inches, and 20 feet high, and is divided into three parts, boiler room, pump room and engine and dynamo room, and has a signal tower on the roof. The roof is composition; all floors are concrete.

### THE BOILER PLANT.

The boiler room is 54 feet 4 inches by 62 feet 2 inches. The plant consists of four Babcock & Wilcox water tube safety boilers, each of 250 horse power. The furnaces are fitted with revolving grates. Slack coal is used. Coal is delivered directly into the boiler room from a track on the north side of the house.

The smoke-stack is self-sustained, 170 feet high and 8 feet in diameter, built up of boiler iron 5-16 inch thick at the base and tapering off to ¼ inch at the top.

The four boilers are connected to an 18 inch header, from which the main steam pipe leads to the engine and dynamo room.

### THE PUMP AND HEATER PIT.

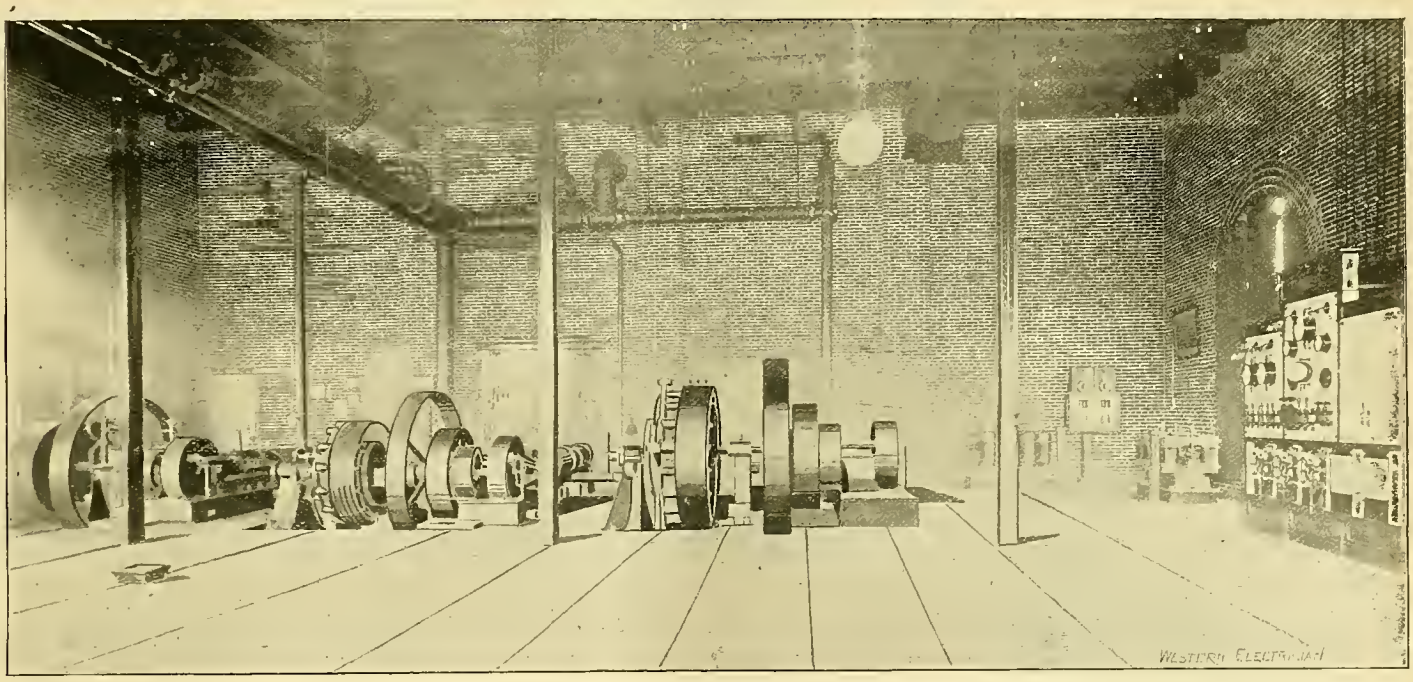
Between the boiler room and the engine room is the pump room, 20 by 34 feet, the floor of which is depressed some 10 feet below the main floor. In this are located two Excelsior 1,000 horse power heaters and two duplex feed pumps; also a receiver, into which drains the condensed water from some 1,900 feet of heating pipe in the union station.

The power house is heated by exhaust steam from the engines, but suitable connections with live steam are also provided. Adjoining the pump room is a store room, 16 feet 6 inches by 20 feet, from which leads a stairway up to the signal tower.

A subway, 3½ by 4 feet, leads to the union station. In this subway is laid a 12 inch pipe, carrying steam at a pressure of five pounds for heating purposes in the main building; also an 8 inch pipe to return the condensed water to the receiver in the pump room.

### THE ENGINE AND DYNAMO ROOM.

The engine and dynamo room is 54 feet by 62 feet 2 inches and 20 feet in height, with concrete floor. The engine and dynamo foundations are of concrete. The generating plant consists of two Buckeye tandem compound 100 horse power engines, each directly connected to two 70 kilowatt Siemens & Halske slow speed four pole interior field direct current dynamos running at a speed of 230 revolutions per minute; also, one Buckeye tandem compound 200 horse power engine directly connected to a 140 kilowatt Siemens & Halske slow speed four pole interior field direct current dynamo commutating directly on the armature bars and running at a speed of 214 revolutions per minute. These generators give a nominal pressure of 485 volts on the bus bars and have a normal capacity of 5,000 incandescent and 300 arc lights. In the illustration the large unit is seen just to the right of the center and the two smaller units are at the left.



POWER HOUSE OF THE ST. LOUIS UNION STATION.—DYNAMO ROOM.

There are two Siemens & Halske five-wire equalizers—one of which is held in reserve—running at a speed of 1,650 revolutions per minute and giving a pressure of 125 volts with a maximum current of 50 amperes to each section of the five wire system, and maintaining a constant pressure of 110 volts at lamp terminals in the union station, a distance of some 3,000 feet. These equalizers are seen to the right in the illustration, just beyond the switchboard.

On a handsome marble switchboard, which is shown in the illustration, are mounted the usual switches, voltmeters, ammeters and regulating devices. Carpenter enamel rheostats are used to regulate the shunt fields. Notable among switching devices is the Siemens & Halske field break, a device for opening the shunt field without danger of rupturing the insulation by the self-inductive discharge. The method consists in switching into the field circuit which is to be broken a device resembling an arc lamp with large

carbons and then slowly separating the carbons by means of a worm gear worked by hand. This movement first strikes an arc which is gradually lengthened until it breaks, thus introducing into the circuit a resistance varying rapidly from zero up to infinity.

LINE CONSTRUCTION.

The line is overhead construction, partly on poles and partly through the train shed, and has a length of 3,000 feet to the center of distribution. It is arranged on the Siemens & Halske five-wire system of distribution. The outside mains are composed of two wires, each having an area

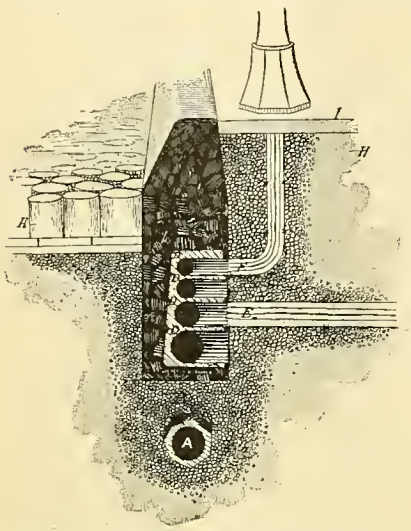



FIG. 2. COMBINED CURB AND CONDUIT SYSTEM.

of 250,000 circular mils, and the three neutral leads are of 0000 wire, or a total area of 1,634,800 circular mils for lighting purposes. There is also a special circuit of two 0000 wires for supplying two Hale electric elevators.

ELECTRO-PNEUMATIC SWITCH AND SIGNAL SYSTEM.

The system used is that of the Union Switch & Signal company, Swissvale, Pa., and embodies all the recent developments of this company in switch and signal work.

In the engine and dynamo room is also located two air compressors, each of 60 horse power capacity, for operat-

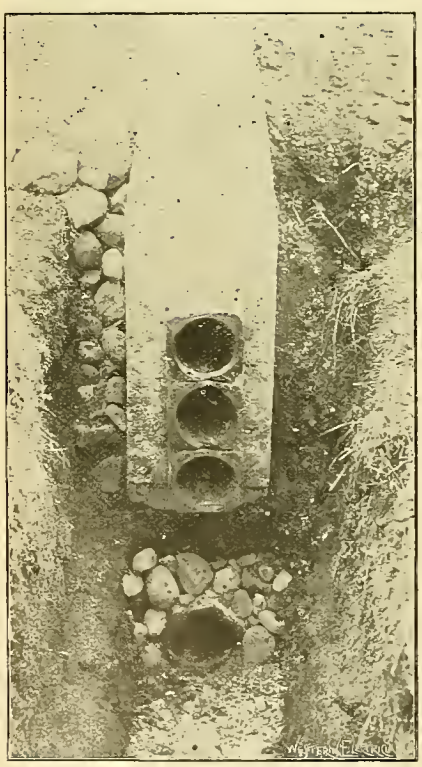


FIG. 1. COMBINED CURB AND CONDUIT SYSTEM.

ing the electro-pneumatic switch and signal system. These maintain a constant pressure of 80 pounds on a system of underground pipes extending throughout the yards and operating all switches, semaphores and air whistles. The pneumatic system embraces 5,000 feet of 3 inch pipe and 4,000 feet of ¾ inch pipe.

In the engine room is also located a 5 horse power vertical engine, driving a 50 volt 50 ampere Westinghouse enerator, which supplies current for the electrical part of the electro-pneumatic switch and signal system. A Sorley storage battery of 21 cells is provided as an auxiliary.

THE SIGNAL TOWER.

On the roof of the power house is located a signal tower having an unobstructed view of all parts of the yards. From this tower all switches and signals throughout the yards are operated by means of electro-pneumatic devices. From the air compressors in the power house a system of underground pipes leads to all switches, semaphores and air whistles throughout the yards. At each switch connection is made with a cylinder in which moves a piston and rod, which connects with a switch lever moving the switch points. An electro magnet at each switch controls a pneumatic valve admitting air to the cylinder at one end and exhausting from the other end and thus moving the switch points. The electric circuits controlling these devices are all laid underground, the total length of wire used being about 127 miles, divided into 806 circuits..

CONTROLLING AND INTERLOCKING DEVICES.

In the signal tower these various circuits are controlled by 64 switch levers, operating 82 switches and 12 movable point frogs, making a total of 130 switch points. There are also 38 signal levers operating 103 semaphores.

These 64 switch levers and 38 signal levers are arranged on the interlocking plan; that is, no lever can be moved out of its normal position until all other levers controlling or relating to the same line of rails, switch points and signals are in their normal position, and no semaphore signal can be moved until all switch points covered by it have been moved into their proper position. Every movement of a switch point or semaphore signal is repeated back to the signal house, showing positively that the switch point or semaphore has been thrown to its proper position. A miniature set of semaphore signals in the signal tower is operated by these repeat-back circuits, thus showing to the operator the exact position of every semaphore.

In addition to this an exact model of the yards is arranged on a board in front of the interlocking lever case. Each track and switch point is represented by small brass rods. The movement of every switch in the yards is reproduced on this model board, thus enabling the operator to see the position of every switch. This also is operated by the repeat-back circuits.

Track circuits—that is, circuits connected to the two rails and operated by the presence of a train on the rails—are used. Air whistles are located at the several semaphore bridges as additional emergency signals for directing the movement of trains in special cases. Every precaution possible is taken to guard against errors and accidents.

All semaphores and switch signals are lighted by 110 volt lamps. No oil lamps are used. The wiring for these lights is placed underground in the same conduit with the signal wires.

## Rochester Railway Matters.

The Rochester, N. Y., Railway company, which owns and operates all the street railway lines within the city, has secured control of the Rochester Electric company's lines under a lease for fifty years, which was closed last week. The former company agrees to guarantee 8 per cent. upon the capital stock of $200,000 of the latter company. The Rochester Electric Railway company owns the line extending from Rochester to Ontario Beach, a summer resort on Lake Ontario. The company was incorporated in August, 1887, and has been running its cars in connection with the lines of the Rochester Railway company. It operates 12 motor cars and 11 trailers and its power plant has a capacity of 450 horse power. The entire electrical equipment is of the General Electric type. The receipts of the road last year amounted to $56,425, an increase of nearly $10,000. over the previous year, and a net profit of $16,883. It is believed that this will prove a valuable acquisition to the Rochester Railway company as that corporation will be in a position to offer extra inducements to patrons in the way of improved service and other advantages that could not be given by the old company.

## Combined Curb and Conduit System.

BY GUSTAVE MONRATH, E. E.

Among the questions pressing upon the electrical engineering departments of large cities is the problem of electrical distribution. Overhead wiring, which undoubtedly is the cheapest and most practical for small cities, is absolutely out of place in a city like Chicago; and before many years the public will demand that all electric wires, not only for electric light and power, but also for telegraph, telephone, fire alarm and watchman alarm systems, be placed underground, and that the unsightly telegraph poles, now encumbering many of our best residence streets, be entirely dispensed with. The work of placing all these

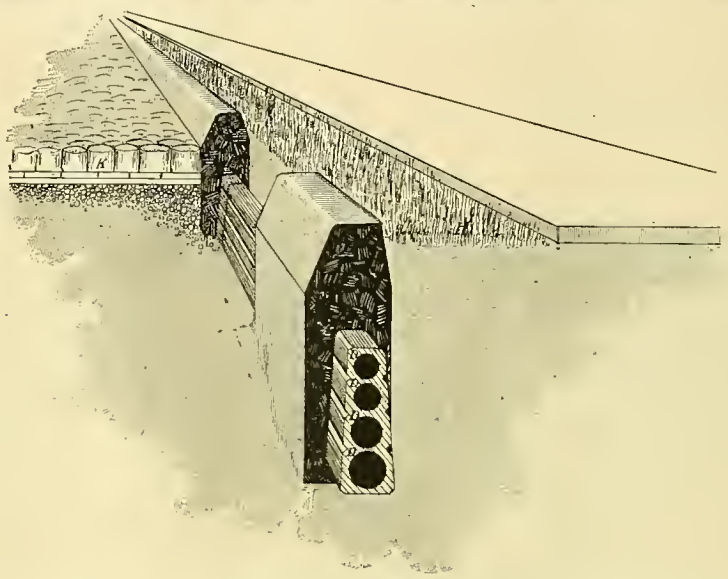



FIG. 3. COMBINED CURB AND CONDUIT SYSTEM.

wires underground is a problem which will require more than ordinary engineering skill, and, besides, it will require a comprehensive system of underground conduit especially adapted to the situation in large cities.

A step in this direction, embodying almost everything which can be desired by an electrical engineer for a complete and perfect conduit system for electrical distribution, is shown in the accompanying illustrations, which represent the Sampson combined curb and conduit system recently patented.

As the name of the system indicates, it is the plan of the inventor to have his conduits embedded in the curbstones, leaving the middle of the street in the undisturbed possession of gas and water companies and relieving the electrical conscience forever of all blame for torn-up streets and poorly replaced pavements. Referring to the illustrations, Fig. 1 is a reproduction of a photograph of a section of this curb conduit in the ground; Fig. 2 is a sectional drawing of a curb with four conduits, with upper ducts for street and house wiring, and Fig. 3 shows the method of construction.

This design of the new conduit system is intended principally for the residence parts of large cities, and has been adopted by the Norwood Park Electric & Construction company, which has purchased the patent rights for Norwood Park, Ill., and intends to utilize it exclusively in the construction of its electric light plant.

In placing the Sampson combined curb and conduit a trench of suitable width and depth is dug along the curb line of the street, and wholly outside of the driveway, so as not to disturb the paving of the street except at crossings. The old curbing is removed, and the trench thoroughly flushed and tamped. A three-inch drain tile is then laid to the necessary grade and surrounded with sufficient gravel or crushed stone to a depth of 10 inches. The gravel or stone should be well compacted around the tile, and the tile connected to the catch-basins. The conduit, which is made of vitrified tiles laid in concrete and furnished in sections of four feet containing as many ducts as desired, is now placed on top of the gravel, the sections two feet

apart, and is lined up and tamped tight. The ducts of the two adjacent sections are then joined together by tiles kept in position by a mandrel pushed through the ducts; a sheet steel frame or mould is placed from section to section on the outside, and a mixture of concrete and Portland cement cast around the tiles, securing a perfect air and water tight joint, and finally the curb is faced with cement and sand and dressed smooth with trowel and brush. At such points as may be desired a T-shaped tile or duct is laid for house or street lamp connections, and all ends are sealed with plugs until such time as connections are to be made. At street corners and at such other points as a change in grade or in the alignment of the curb may necessitate, manholes are to be built of sufficient size to permit drawing, splicing and tapping of cables.

The drainage of the conduit system is provided by means of suitable tile connections from the floor of the manholes to the sewer system, and ventilation is obtained through the manholes and ducts running into the lampposts. In crossing streets the conduit will be constructed in the same manner as the combined curb and conduit, except that no part of it will be brought above the surface of the street.

The advantages of this system are quite evident. The material used in its construction is practically indestructible and improves with age; the vitrified pipe is a good non-conductor, impenetrable to water, and its smooth, glazed surface offers little resistance to the drawing of cables. All connections, both for house and street lighting, can be made without disturbing the street pavements, T branches with ample hand room being placed at intervals of 25 feet.

By the combination of a conducit and curbstone the conduit system is entirely out of the way of gas and water pipes, which are always unpleasant neighbors for electric wires, and the sub-drainage of the curb is of great advantage to the roadbed, especially on unimproved streets, keeping them well drained at times when they would otherwise he almost impassable. The cost of this conduit system does not amount to any more than ordinary curbs and corresponding pole lines. This system of underground conduit can also be adapted for the business part of a city by combining the conduit with an area-wall, built similarly to the curbstone, and which would facilitate the connection of light and power circuits to house wiring without the necessity of obtaining a special permit for opening the streets everytime a tap wire is wanted.

## Dissipated Lightning.[1]

And now at last there comes a man
Who has, I'm told, devised a plan
To shield us from a dreadful fate
By making lightning dissipate.

Indeed, ere this, full many a wight
Himself hath found in so sad plight,
With Jersey lightning partly sated,
He felt extremely dissipated.

The plan proposed by Mr H——s
The shrewdest is of many dodges –
"To save *yours* If from such a fate
Make your conductor dissipate."

You haven't any, do you say?
Well, well, there surely is a way –
Of course, you buy one, don't you see,
From H——s or his companee.

Which makes, the advertisements state,
Conductors that *will* dissipate.
Lord bless me—a forgetful feller –
I should have called it a "dispeller."

So H——s calls it - 'tis so odd –
His dissipated lightning rod,
That bursts so quickly with the fluid,
Must be as often quick. renewed.

Or else repeated lightning flash
May on you, unprotected, crash.
In epitaph above your sod–
"Died of a busted lightning rod"

Or you survive by merest luck,
When your dispeller has been struck—
Put not your trust, as you began,
In a "dissipated lightning" man.

Keep out of such bad company,
From dissipation ever free--
Dispel your fears, discharge alarm,
No Jovian bolt can do thee harm,

If strong and good and near are found,
With good connections to the ground,
Conductors free from dispellation,
To *neutralize* the emanation.

Then lift thy voice and cry aloud
So it be heard by all the crowd –
"To soak the lightnen though they're able
*My* conductors are *not* dissipable."

1. Dedicated to Hodges, apropos of page 98, second column WESTERN ELECTRICIAN, September 1, 1894.

## Municipal Plant at Austin, Tex., for Water, Light and Power.

By Frank E. Scoville.

The municipal plant at Austin, Tex., for furnishing water, light and power, which is now in course of construction, is one of the most extensive enterprises of the kind in the country, and in many respects is an unique undertaking. The city has a favorable location on the north bank of the Colorado river, where the latter emerges from the high country on the northwest. The advantages of this position were early recognized by the business men of Austin, and several years ago the movement looking toward the utilization of the immense water power was begun. Engineers were employed by local capitalists to make investigations and surveys and collect data upon the subject, and five years ago the project had assumed so much importance that it became an issue in the local election. John McDonald, who was elected mayor in 1890, was one of the leading advocates of the scheme, and under his direction measures were at once taken to advance the project. One of the first steps taken was the employment of competent engineers to make plans and compile data that would be of value in directing the work. Joseph P. Frizell of Boston, Mass., was employed to make a preliminary survey. His report was very complete and was submitted to the city council at a special session held in the opera house, which was filled with representative citizens.

FIG. 1. MUNICIPAL PLANT AT AUSTIN, TEX., FOR WATER, LIGHT AND POWER.

This report was very encouraging to the friends of the enterprise, and when in March, 1890, John Bogart, the eminent state engineer of New York, who was employed to examine Mr. Frizell's statement, made a favorable report, it was determined to proceed at once with the enterprise. The question of raising money to defray the expense was submitted to the people at a special election at which only taxpayers were allowed to vote. The proposition was whether the city should issue bonds to the amount of $1,400,000 to pay for the work of erecting the dam, laying water mains, erecting a power house and complete pumping, electric light and power plant. The result was an overwhelming victory for the friends of the scheme, there being 1,354 votes in favor of the plan as against 50 opposed to it.

When the city was authorized to issue bonds, plans were immediately ordered and contracts let for the construction of the dam proper and excavation for the power house. Mr. Frizell, having been previously elected chief engineer of the Board of Public Works, was placed in immediate charge of this work. Operations were at once commenced; the first masonry was laid on May 5, 1891, and the last stone was set in the dam on May 2, 1893. The dimensions of the dam are as follows:

| | | |
|---|---|---|
| Length of rollway | 1,090 | feet. |
| Length of bulkhead and headgate | 270 | " |
| Total length over all | 1,360 | " |
| Width of base | 66 | " |
| Height above low water | 60 | " |
| Total height above foundation | 68 | " |

J. T. Fanning of Minneapolis, Minn., consulting engineer to the Board of Public Works, estimates the capacity for ten hours a day to be not less than 14,000 horse power.

The dam is built of granite faces and a core of rubble limestone masonry. All granite and rubble masonry was laid in Portland cement. The total cost of the dam, including extras, was $611,313.29.

Water will be taken to the turbines through iron penstocks set in the headgate masonry at the east end of the dam, as shown in the illustration, Fig. 1.

The power house is to be built immediately below the headgates. The headgate masonry is 108 feet long and carried up 16 feet above the crest of the dam, it being estimated that at times of great floods the dam would have to pass a depth of at least 14 feet on the crest.

There are seven penstocks nine feet in diameter, four of which will be used by the city for operating the water supply and the electrical machinery, the other three to be used as a reserve power for manufacturing purposes.

The power plant consists of two vertical turbines, each of 200 horse power capacity, for operating the pumps, and four pairs of horizontal turbines, each pair to have a capacity of 506 horse power. These are to operate the electrical machinery. These turbines are of the Stillwell-Bierce & Smith-Vaile company's make, and with two 4,000,000 gallon water power pumps will cost about $38,000.

The power house is being built after plans furnished by Engineer Fanning, the construction work being under the supervision of Joseph Kepferle, who has been engaged in this work since the first stone was laid in the dam. He was promoted to engineer in charge last February.

In May, 1893, just after the completion of the dam, a break occurred in the eastern bank of the river, which carried away about 70 feet of the headgate masonry and a part of the powerhouse site. The break was found to be due to a fault in the limestone formation. The headgate was taken out, with the exception of the part enclosing the two penstocks next to the dam. These repairs were completed in March, 1894, at a cost of about $64,000.

The lake formed by the dam is about 27 miles long, and covers an area of about two thousand acres. It was named Lake McDonald by the City Council in honor of Mayor McDonald, who has given his entire time to the work for the last four years.

The electrical machinery will consist of three Wood arc dynamos, with a capacity of 80 450 watt lamps each; four 3,000 light and two 1,500 light Wood alternating generators at 2,000 volts; two 130 horse power 500 volt General Electric generators, and one 180 kilowatt three phase generator, all to be connected of course with the city, a distance of 3¼ miles.

The accompanying illustrations serve the double purpose of showing some interesting features of the work and at the same time conveying an idea of the magnitude of the enterprise. Fig. 1 shows the dam with penstocks set in the headgate masonry, the power house site just below. At the time the photograph was taken from which this cut wa

reproduced the last stone in the dam had just been placed, May 2, 1893. Fig. 2 shows the power house site with part of the foundation and some of the machinery in position, while Fig. 3 shows the bulkhead and pool below the dam, with 5.9 feet of water over.

The entire city is being wired, and the pole line will require at least 2,000 poles. The street lighting is to be by the tower system. There are employed 31 towers of the Star Iron Tower company's make, 150 feet high, each with six 450 watt arc lamps. The towers are now in position, and the city is wired for 15,000 lights. Some delay will be caused in this work by the loss of about five hundred poles during the recent labor troubles in Chicago.

Edward J. O'Beirne, state agent for the Fort Wayne Electric company, is giving this contract his personal supervision, and when finished it will be as complete as any light and power plant in the Southwest.

The city council proposes to furnish lights at about 25 cents per 16 candle power lamp, with meter and power rates in proportion.

## Important Patent Decision.

In the United States Circuit Court of Appeals for the Third Circuit Judges Acheson, Dallas and Butler handed down a decision at Philadelphia on September 11th, reversing the decision of the Circuit Court of the United States for the District of New Jersey, in the case of the Edison Electric Light company against Westinghouse, Church,

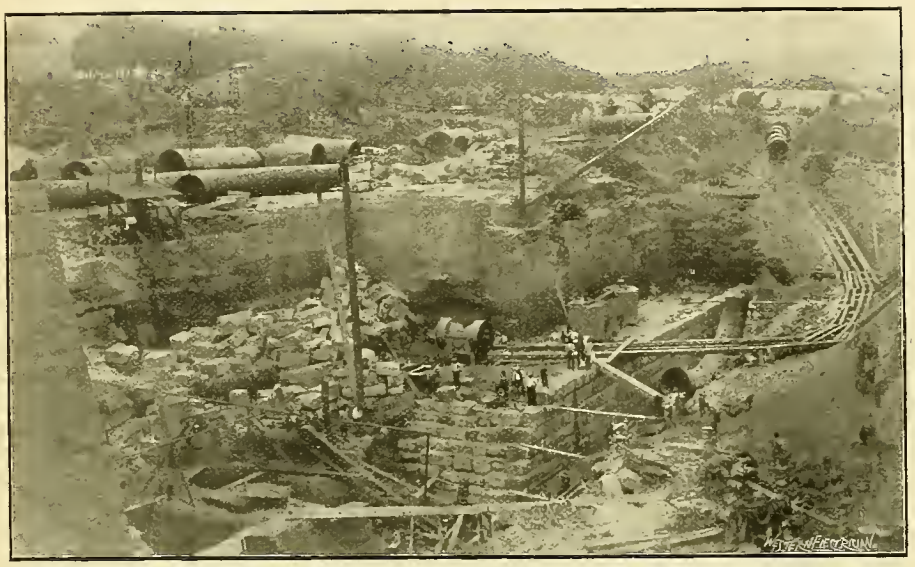


FIG. 2. MUNICIPAL PLANT AT AUSTIN, TEX., FOR WATER, LIGHT AND POWER.—SITE OF POWER HOUSE.

Kerr & Co., from which an appeal had been taken. Judge Acheson wrote the opinion, which is herewith appended:

This suit was for the alleged infringement by the defendant of letters patent of the United States to Thomas A. Edison, No. 264,642, dated September 19, 1882, granted upon the application filed August 9, 1880, for an "electric distribution and translation system." After stating that the "invention relates to a method of equalizing the tension or 'pressure' of the current through an entire system of electric lighting, or other translation of electric force, preventing what is ordinarily known as a 'drop' in those portions of the system the more remote from the central station," the specification proceeds thus:

As is well known from patents already granted me, and prior applications pending, I use in my system an electric light formed of a continuous incandescing conductor, large numbers of which are grouped into one system, supplied and regulated from a central station, main conductors leading from and to the central station, each lamp or translating device being in a derived circuit to the main conductors, the entire system being what is known as a "multiple arc" system. From a central station the main conductors may proceed, and it is intended that they should, to a great distance, and supply a large number of translating devices. In such cases there is inevitably a difference in tension between various parts of the circuit due to the resistance of the main conductors. This may be partially remedied by making the conductors very large near or at the station, gradually decreasing their size or conducting capacity; but such plan only lessens slightly the ratio of fall. To obviate the difficulty I provide feeding conductors, which extend from the generator or generators to the main conductors of the lamp or consumption circuit or circuits, such feeding conductors not having any translating devices connected therewith, and being connected with the main conductors of the consumption circuit or circuits at the center ends or other points on such main conductors. From a central station several sets of such feeding conductors may run, each set feeding into its own lamp or consumption circuit or all the sets feeding into a connected system of lamp or consumption circuits. It will be seen that the drop upon the feeding conductors has no effect upon the relative candle power of the lamps of the system, the relative candle power of the lamps being affected only by the drop upon the main conductors of the consumption circuit or circuits between the end of a set of feeding conductors and points most distant from any feeding conductors. In order to maintain practically the same candle power throughout the system, the main conductors of the consumption circuit or circuits should be so proportioned that the drop in tension upon them shall not exceed a definite small limit; for example, five per cent. This drop will make a difference of less than a candle power in all the sixteen candle power lamps of the system, which difference is not perceptible to the eye. Upon the feeding conductors however, any loss can be made. This loss will be varied according to localities, and the relative cost of copper for conducting purposes and horse power for generation. This loss upon the feeding conductors, in large and extended systems, will generally be greater than upon the main conductors of the consumption circuit or circuits. It may be, for example, about 15 per cent.; but circumstances might make it desirable to diminish the loss upon the feeding conductors down even as low as that upon the main conductors of the consumption circuit or circuits, or to increase the loss upon the feeders to more than fifteen per cent. * * * When it is desired to use a few lamps near the central station, they may be placed upon a direct circuit therefrom, with resistance at the commencement or home end of the circuit sufficient to then reduce the tension of the current in such circuit so that it shall only be equal to that in the more distant circuits, and one or more such circuits may be combined with the circuits before described. When large buildings or blocks of building using many lamps are to be supplied, it may be desirable to lay therefor separate feeders insulated from each other. Where several central stations are used in a city, each having feeding conductors leading to lamp-circuit conductors of the description before noted, it may be advisable to connect the feeding circuits of all the stations, equalizing the tension or pressure throughout the entire system of the place where the central stations are located.

The illustrative drawings show different applications of the general form of circuit described in the specification. The patent has six claims, but the defendant was charged only with the infringement of the first, second and third claims, which are as follows:

1. A consumption circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle power of the lamps connected therewith in combination with feeding conductors connecting the consumption circuit with the source of electrical energy, and having no translating devices connected therewith, the drop in tension upon such feeding conductors not affecting the relative candle power of the lamps of the consumption circuit, substantially as set forth.

2. A consumption circuit, in the main conductors of which there is a definite small drop in tension, not sufficient to vary practically the candle power of the lamps connected therewith, in combination with feeding conductors connecting the consumption circuit with the source of electrical energy, and having no translating devices connected therewith, the loss upon such feeding conductors being greater than upon the main conductors of the consumption circuit substantially as set forth.

3. The combination of a consumption circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle power of the lamps connected therewith, with a feeding circuit having no translating devices, and extending from the source of electrical energy to the center of the consumption circuit, substantially as set forth

For the proper determination of this case it is essential that the subject matter of these claims should be clearly understood. This patent does not deal with the complicated general problem of the distribution of electricity and the subdivision of the current for the purpose of domestic illumination. The patent is not for an incandescent lamp, or for a dynamo for generating electricity, or for the arrangement of the lamps in multiple arc, or for indicating and regulating devices for controlling the current from a central station, singly or combined. The patent deals with the one particular difficulty of drop in tension or fall of pressure—loss of electromotive force, due to the resistance of the conductors to the electric flow. To remedy the evil effect therefrom, the patentee provides special conductors for the transmission of electricity, extending from the generator to the main conductors with which the lamps are connected and from which they are served. The patent is for a specific arrangement and proportioning of the two sets of conductors which together constitute the complete circuit.

The claims in question are perfectly clear and definite. Each claim is for a combination consisting of two constituents, namely, a consumption circuit in the main conductors, of which the drop in tension is not sufficient to vary practically the candle power of the lamps connected therewith, and feeding conductors (a feeding circuit) having no translating devices thereon, uniting the consumption circuit with the source of electrical energy. Any electric consumption circuit, the main conductors of which are so proportioned that the drop in tension therein is not sufficient to vary practically the candle power of its lamps, in combination with feeding conductors on which are no translating devices, falls within the scope of the claims. Plainly, each of these claims is for a single circuit composed of a pair of transmitting conductors and a pair of distributing conductors having the specified characteristics without regard to any other like circuit. The gist of the alleged invention is in the combination and proportioning of the two parts of the circuit and not in the scale of use.

Contrary to these views, the Circuit Court was of the opinion that certain unexpressed qualifications are to be incorporated into each of the claims by virtue of the concluding words "substantially as set forth." After discussing the specified limitations, the court said: "But this statement of the claims would be highly inaccurate if permitted to stand alone. Other limitations must be regarded. Not only are the circuits, feeding and consumption, unique in their special characteristics, but, as well, are jointly applicable to the lighting by incandescent lamps, in multiple arcs, of large area, of which portions or parcels are very distant or remote from a central station, from which, however, emanates complete control. It is true that these latter limitations are not expressed in terms in the claims under consideration, or in either of them. But, in draughting the claims, Mr. Edison, by the words used, clearly referred to the descriptive phraseology of the specifications of his invention preceding them."

Accordingly, the court construed these several claims as involving the lighting of a "large territory" by the use of "large numbers" of incandescent lamps, and as implying central station regulation whereby variable drop in tension in remote parts of the system may be controlled. But, in our judgment, these limitations are inadmissible. The fact is, pending the application for this patent, it was sought to amend the specification and insert a new claim by the introduction of the matter of central station regulation, but the Patent Office rejected the proposed amendment for the assigned reason that "it describes and claims an invention not even hinted at in the original specification nor shown in any of the drawings."

While central station regulation is incidentally referred to in the introductory part of the specification, it is not described at all, and clearly is no part of this alleged invention. The only described means to secure equality of pressure between the lamps of a circuit near the central station and the lamps of a circuit more remote therefrom are resistance coils put in the supply conductors of the near circuit. This device is covered by the fifth claim, infringement of which is not charged.

The claims in question are unambiguous and exact. Upon well settled principles, then, limitations other than those expressed are to be excluded (Railroad company vs. Mellen, 104 U. S., 112; Yale Lock company vs. Greenleaf, 117 U. S., 554; White vs. Dunbar, 119 U. S., 47, 52). As was said in the last cited case, "the claim is a statutory requirement, prescribed for the very purpose of making the patentee define precisely what his invention is, and it is unjust to the public as well as an evasion of the law, to construe it in a manner different from the plain import of its terms." The claims here, we think, were purposely framed broadly, so as to cover the simplest form of the alleged invention.

The claims with which we are concerned, as we have seen, are each for a combination of two elements, a consumption circuit and feeding conductors having respectively the peculiar properties specified. The primary question for solution, then, is, whether it involved invention in a patentable sense to combine a circuit for feeding only with a consumption circuit, the main conductors of which are so proportioned as to maintain such uniformity of pressure upon them that there is practically no variance in the candle power of the lamps connected therewith.

Now a claim for a combination carries with it an implication that the separate elements are old. Says Justice Bradley, speaking for the court, in the case of the Cornplanter Patent, 23 Wall., 181, 224: "Where a patentee after describing a machine claims as his invention a certain combination of elements, or a certain device, or part of the machine, this is an implied declaration, as conclusive so far as that patent is concerned, as if it were expressed, that the specific combination or thing claimed is the only part which the patentee regards as new." In the present instance the positive proofs accord with the implication. Most certainly the patent in suit discloses no new means either for transmitting a current of electricity or for equalizing pressure upon the consumption circuit.

It is to be noted that the patent leaves it altogether to the judgment of the electrical engineer or contractor to determine the relative lengths of the two parts of the combined circuit and the proper thickness of the conductors. As to these points no definite instructions are given. Undoubtedly, it was well known prior to the alleged invention that a large quantity of electrical energy could be transmitted a considerable distance by a conductor of small size. Now with respect to the loss of pressure upon the feeding conductors—which loss depends upon the thickness of the conductors—the specification tells us that "this loss will be varied according to localities and the relative cost of copper for conducting purposes and horse power for generation." It is said that in large and extended systems this loss would generally be greater than the loss upon the main conductors of the consumption circuit, and "may be, for example, about fifteen per cent.;" but that circumstances might make it desirable to diminish the loss down even as low as that upon the the main conductors of the consumption circuit, or to increase the loss upon the feeders to more than fifteen per cent. Thus is it left where, indeed, it properly belongs—to the intelligence of the electrical engineer to select feeding conductors of larger or smaller diameter, depending upon the comparative cost of copper and of power, or upon some special circumstances.

Of a truth, the feeding conductors of the patent are nothing more than the ordinary supply wires running from the source of the electrical energy. The proper function of such conductors being to transmit the electric current to the point where it is to be utilized, as a matter of course they have no "translating devices connected therewith." The statement in the specification—"It will be seen that the drop upon the feeding conductors has no effect upon the relative candle power of the lamps, being affected only by the drop upon the main conductors of the consumption circuit or circuits between the end of a set of feeding conductors and points most distant from any feeding conductors"—is the mention of an obvious fact. Indeed, it is put as a self-evident proposition. That no loss upon the supply part of the circuit can affect the relative candle power of the lamps upon the consumption part of the circuit is a quality inhering in the circuit by the very nature of things. It is a necessary incident of any circuit, part of which supplies the current and part of which distributes it.

The specification states that "in order to maintain practically the same candle power throughout the system, the

main conductors of the consumption circuit or circuits should be so proportioned that the drop in tension upon them shall not exceed a definite small limit.- for example, five per cent.," but gives no information whatever how that is done. This silence is highly significant. The specification assumes that to secure uniformity of electrical pressure, and thus uniformity of effect, is a matter of common knowledge among those skilled in the electrical art, as indeed it was. The drop or fall in tension or pressure in an electrical current in its passage through a conductor was an observed and well understood phenomenon long prior to the year 1880. It was known that its cause was the resistance offered by the conductor to the flow of the current, and the laws governing the flow of electricity and the drop in tension had been ascertained and published, and were perfectly familiar to all skilled electricians. They understood the effect upon the drop in tension of variations in the size and length of the conductor and of changes in the electromotive force of the generator: and the ascertainment of the proportions to be given to a conductor to secure a definite fall in pressure with a given current was a mere matter of calculation, to aid which formulæ had been worked out.

In the art of electroplating as practiced long before 1880 we find an arrangement of circuits substantially the same as that of the patent in suit. Here a large number of articles to be plated simultaneously are suspended in the bath by separate wires attached to a metallic rod placed across the top of the tank; that is to say, the articles are arranged in multiple arc with respect to the electric current. The rod is supplied with the current by conducting wires which connect the rod with the dynamo, and the current divides among the suspended articles. It will be perceived that here one part of the circuit is used exclusively for transmitting the current and the other part for distributing it. Equality of electric pressure among the articles to be treated is essential to good work, and, in fact, the distributing rods were made of such size that any material fall in pressure was avoided.

Turning now to the Khotinsky French patent of 1875, which relates to the art of electric lighting, we discover that it shows and describes a circuit of feeding and consumption parts in combination, identical in form with that of the patent in suit. The lamps of Khotinsky's system are incandescent lamps, and they are arranged in mutiple arc. He shows a magneto-electric machine located "in the center of this system or at any other point." From the magneto-electric machine run two "conducting wires" with which no translating devices are connected. These conducting or feeding wires connect with the "main conductors" of the circuit with which all the lamps are connected. In his diagrams 1 and 3 the feeding conductors connect with the center of the consumption circuit and in diagram 2 at the end. Undeniably Khotinsky's combined arrangement of feeding conductors and distributing conductors is precisely the arrangement of the patent in suit. Nothing indeed is said by Khotinsky about proportioning the main conductors of the consumption circuit so as to prevent injurious drop in tension. It was, however, wholly unnecessary for him to say anything upon that subject. All that was needful to overcome the difficulty due to drop in tension was to make the main conductors of the consumption circuit of proper thickness. The laws governing the flow and distribution of electricity in conductors were perfectly well known to electricians at the date of Khotinsky's patent, and any electrical engineer of ordinary skill then called on to construct a circuit of Khotinsky's system, it is to be assumed, would have acted in accordance with common electrical knowledge, principles and practice; in other words, he would have made the main conductors of the consumption conduit sufficiently large to be of practical utility.

How can it be affirmed that it would require invention simply to proportion Khotinsky's circuit in the manner contemplated by the patent in suit—to make his transmitting wires and distributing conductors, respectively, of suitable size to perform their intended functions?

Now, it is quite true that prior to the year 1880 electric lighting for ordinary domestic purposes was not an accomplished fact. But this was not for lack of anything shown by the patent in suit. The great *desideratum* was a practical incandescent lamp. Such a lamp, with a filamental carbon conductor of high resistance and burning with a very small amount of current, was devised in or about the year 1879, and it solved the problem of the practical subdivision of the electric current for incandescent lighting. The principle of this lamp was pronounced by Justice Bradley, in the Consolidated Electric Light company vs. McKeesport Light company, 40 Fed. Rep., 21, 29, to have been "the grand discovery in the art of electric lighting, without which it could not have become a practical art for the purpose of general use in houses and cities." Such were the views which prevailed in the Second Circuit in the case of the Edison Electric Light company vs. United States Electric Lighting company, 47 Fed. Rep., 454; 52 Fed. Rep., 300, where it was decided that Mr. Edison was the first and original inventor of this lamp.

Under the proofs, we cannot assent to the suggestion that the alleged invention here in question supplied a long-felt want, or met a difficulty generally recognized in the art as a serious hindrance to the distribution of the electric current. In fact, prior to the application for this patent, no incandescent electric lighting plant had been built. There had been no occasion to erect such plants, for no practically successful incandescent lamp had yet been furnished to the public. Hence, electrical engineers had not been called upon to deal practically with the problem of drop in tension in the construction of such plants. In truth, the feeder and main system of distribution came naturally, in the ordinary progress of the art of incandescent electric lighting, as and when needed.

In his Cantor Lectures of February, 1885 (put in evidence by the plaintiff below), Prof. George Forbes, speaking of this feeder and main system, well said: "It is a result which would certainly have been arrived at by any one who thoroughly and intelligently worked out the problem." True, he added that, so far as he could discover, Mr. Edison "was the first, by a long time, to hit upon this cure for the evil." But this latter statement is without significance when we reflect that a practical incandescent lamp—without which domestic electric illumination was impossible—was invented so short a time before the application for this patent, and that, when the occasion for its use actually arose, the feeder and main system was forthcoming.

It is a great mistake, as the proofs demonstrate, to attribute to the patent in suit the merit of having solved the problem of economically supplying the requisite current for extensive use to circuits covering large areas, portions of which are at great distances from the source of electrical energy. Whatever of economy in copper may result from the plan of the patent is confined altogether to the transmitting conductors, and the cost of copper restricts the use of this system to comparatively narrow limits. The extension of incandescent electric lighting over large areas is really due to subsequent inventions. Conspicuous among the more recent discoveries and improvements which have brought incandescent lighting into extensive and common use is the converter or alternating current system, whereby the electric current is transmitted from the generating station to a very great distance at an extremely high pressure, and is converted at the points of distribution with the low-pressure currents required by the incandescent lamps.

The multiple arc or derived-circuit system of distribution being confessedly old, and the high resistance incandescent lamp having been devised to provide "feeding conductors which extend from the generator or generators to the main conductors of the lamp of consumption current," was, it seems to us, an obvious engineering expedient. Then, as already shown, the proper proportioning of the two parts of the combined circuit involved only the exercise of the common knowledge and skill of the electrician. The facts, we think, clearly bring this case within the principles announced by the Supreme Court in the case of Hollister vs. Benedict, etc., company, 113 U. S., 59, and in kindred cases. The plan of electric distribution covered by the claims in question is not "the creative work of that inventive faculty which it was the purpose of the constitution and patent laws to encourage and reward." To sustain these claims would be to sanction a monopoly in that which belongs to the public.

In announcing this conclusion we cannot do better than quote some observations of the Supreme Court which apply with great force to this case, as we read the proofs. In Atlantic Works vs. Brady, 107 U. S., 192, 199, the court said:

> The process of development in manufactures creates a constant demand for new appliances, which the skill of ordinary head-workmen and engineers is generally adequate to devise, and which, indeed, are the natural and proper outgrowth of such development. Each step forward prepares the way for the next, and each is usually taken by spontaneous trials and attempts in a hundred different places. To grant to a single party a monopoly of every slight advance made, except where the exercise of invention somewhat above ordinary mechanical or engineering skill is distinctly shown, is unjust in principle and injurious in its consequences.

The appellant maintains that under the ruling of the Supreme Court in the case of Miller vs. Eagle Manufacturing company, 151 U. S., 186, the first, second and third claims of the patent in suit are void, because of the grant of an earlier patent to Mr. Edison, No. 239,147, dated March 22, 1881, which dealt with the evil of drop in tension, and provided a remedy by feeding conductors, having no lamps thereon, connected with the mains around the central generating station and so proportioned as to secure equal electrical pressure throughout the entire system. It is contended that the invention described and claimed in the earlier patent is for one form of the alleged invention described in the latter patent and covered by the first three claims thereof, and that no one could use the invention of the earlier patent without infringing these later claims. The question thus raised is a serious one, but we do not deem it to be necessary to consider it, inasmuch as the views we have expressed upon the other branch of the case are decisive.

The decree of the court below is reversed, and the cause is remanded, with directions to enter a decree dismissing the bill of complaint with costs.

## Swiss Electrical Industries.

Dr. A. Denzler, of the polytechnic school at Zürich, has contributed to the *Schweizerische Bauzeitung* an interesting statistical article on Switzerland's electrical industries, the main points of which are summed up in the appended table:

| | 1893. | 1889. | Average increase per year since '89. | Increase in 189-. |
|---|---|---|---|---|
| Lighting stations | 679 | 551 | 82 | 116 |
| Power transmission stations | 77 | 25 | 13 | 24 |
| Storage battery plants | 161 | 41 | 40 | 40 |
| Generators and motors | 1,48 | 5,6 | 2 8 | 551 |
| Combined capacity in kilowatts | 28,832 | 7,660 | 5,412 | 8,2 8 |
| Incandescent lamps | 145 911 | 51,135 | 2,,689 | 30,2-, |
| Arc lamps | 2,125 | 845 | 520 | 582 |

Among the generators in use there are six of 600 horse power each, all of them mounted on vertical shafts directly connected with the driving turbine shafts. Five of these generators are in the large aluminium works at Neuhausen; the sixth, at Dorenberg-Luzerne, is the largest machine now in operation in Switzerland for lighting purposes. Another noteworthy machine is a 100 horse power generator at Schönenwerd, running at the remarkably low speed of only 32 revolutions per minute. The highest voltages used in the plants installed during the year 1893 were those in a paper mill at Biberist, where a direct current of from 6,500 to 7,000 volts is employed, while at the central station at Charmey-Bulle a 3,300 volt alternating current is employed. These two plants also have the longest aerial transmission lines in Switzerland, measuring, respectively, 28.5 kilometers (17.7 miles) and 9.6 kilometers (6 miles). Dr. Denzler also calls attention to the fact that in isolated plants very satisfactory results have been obtained with petroleum motors as prime movers working in conjunction with storage battery outfits.

FIG. 3. MUNICIPAL PLANT AT AUSTIN, TEX., FOR WATER, LIGHT AND POWER.

## Wire Tapping by Boat.

A new scheme of wire tapping was discovered at Washington, D. C., on September 13th by the Western Union officials. The company supplies the outside racing information for the Alexander Island and St. Asaph, Va., pool-rooms. On the day mentioned the company discovered that a connection had been made with its wires on the long bridge. A thin wire ran down from a pole on the outside of the bridge, and was brought just under the bridge flooring and was there caught by a brass piece with a spring attachment. Inserted into this brass piece was a cable wire securely held by the spring. The men who made the discovery began pulling on the cable and found that it led to a sailboat 100 yards out in the river, the occupants of which, being thus warned, hastily cut it. The policemen and the telegraph officials gave chase, but were unable to catch them. So far as known the men had not succeeded in sending any information to their confederates.

## Result of the Forest Fires.

On returning to Duluth, Minn., from a trip through the district recently devastated by the great forest fires, W. F. Moore, chief lineman of the North American Telegraph company, reported that between Rutledge and Pine City he found 310 poles burned and that 11 circuits had to be repaired. The wires were strung on stumps and other temporary supports. The whole line is now cleared up.

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CORRESPONDENCE relating to electricity or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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## HIGH WATER MARK

CIRCULATION, 16,630.

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JUDGE ACHESON declared the "feeder and main" system non-patentable last week when he reversed Judge Green's decision in the Edison-Westinghouse litigation over this question. It is an important ruling, and the opinion which accompanied it and which will be found in this issue is one of the most interesting documents that has been presented for the consideration of the electrical fraternity in many days. It is well worthy of careful perusal.

FOR the benefit of the London *Electrical Engineer*, which desires to learn whether there is an electric traveling crane in existence larger than that at the Seraing Works of John Cockerill & Co. in Belgium, which has a capacity of 60 tons, we may state that at the United States government arsenal at Watervliet, N. Y., a 120-ton electric traveling crane is in operation. This crane is used in transporting the huge masses of metal that are worked up into the great guns turned out at the Watervliet works, and is probably the most powerful electric crane in the world.

SENATOR HILL of New York made an effective speech at a Jersey fair last week in which he pointed out the fallacies of the new-fangled political heresies teaching that the government should own and control everything used by man, including the railroads, the banks, the telegraphs and many other of the manifold industries and enterprises now conducted by individual effort and capital. He declared that such a condition would be fatal to our government. To bring about these things would be the most fatal of mistakes. "It would be unwise," he pointed out, "to add to the official patronage of a national administration, and especially as that patronage is not always wisely dispensed; nor would it be wise to increase the channels of expense." But above all of these considerations is the fact that such a policy is opposed to American principles, and whether it be in the nature of socialism, paternalism or populism, it is alike distasteful to the great mass of thinking people of the country.

ELECTRICITY was used at the Cook County hospital last week by the police to make a shamming criminal acknowledge the truth. It was a successful test, and one that the subject will never forget. It may lead Chicago detectives to make frequent use of electricity in the future. James Orem, a clever burglar, was arrested for personating a police officer. At the police station the culprit feigned sickness, and was taken to the county hospital. When Captain Hartnett was told of Orem's illness he suspected it was a ruse to get away from the police. He telephoned his suspicion to the physician in charge at the hospital and asked that a current of electricity be applied to Orem when the ambulance should arrive. Orem was still apparently unconscious when lifted from the ambulance. The stretcher was placed in the corridor and a current applied to Orem's feet He sprang into the air yelling lustily and bounded beyond the spectators, who had gathered to witness the test. He had reached the street before he was recaptured. He says now that his health was never better.

WITH the opening of the public schools in Chicago it became apparent that the increase in attendance was limited to the outlying wards, and further examination of the reports showed that the increase was most noticeable in districts provided with electric railway service, while there was an equally marked tendency to decrease in the central portion of the city. This remarkable change is accounted for by the fact that the people are gradually deserting the crowded business district and seeking homes in pleasanter and more suitable parts of the city. Even the bitterest foes of the trolley admit that this is due almost entirely to the introduction of the electric railway. It is demonstrated that while the electric lines stimulate municipal growth they have at the same time a beneficent influence in spreading out the people over a larger area and giving them more breathing space and better air. Commenting on the singular showing in the school returns, the *Evening Journal* of Chicago, which has opposed the trolley tooth and nail, says: "There is not the slighest doubt that the electric railways, even the much abused and by no means perfect trolley lines, are working a gradual revolution in our cities and that they are acting as a powerful stimulant to municipal growth all over the United States. If the storage battery ever reaches the stage of perfection that will make it uniformly practical, there will be an immediate revolution in transportation. But even in the absence of this a great revolution is silently and almost imperceptibly changing the conditions of life in our cities. Nothing in the world can now prevent the country for 100 miles around all our great cities from being gridironed within a few years by electric lines. It is absolutely sure that this work, now swiftly going on, will continue, even without the storage battery." And our contemporary adds that if for no other reason than the sanitary improvement it has effected, the trolley car deserves to be commended.

THE question of responsibility for accidents on electric railway lines is now the subject of judicial inquiry in two counties of New Jersey, as the grand juries of Hudson and Essex have been instructed to investigate complaints of this character. In their instructions to the juries Judges Lippincott and Depue explained the application of the law to these cases. According to their interpretation not only an open violation of the law, such, for instance, as operating cars at a higher rate of speed than is permitted by the ordinances, but also any neglect of a legal duty resulting in an accident involves legal responsibility. When these accidents result in death those responsible are liable to indictment for manslaughter, and in cases where personal injury is sustained a charge of assault and battery can be maintained. Judge Lippincott says that "the master who neglects to use reasonable care in furnishing reasonably safe appliances for his workmen, if death results, is guilty of manslaughter, whether it be in the erection of buildings, the running of machinery or any other employment;" and Judge Depue holds that "the single issue presented is whether or not these companies exercise their franchise in such a manner, using the word in its broadest signification, comprising speed, construction of cars, mode in which they are run, the condition of travel in the streets, and all other circumstances —as to unreasonably endanger the lives, safety or property of others lawfully using the streets in their customary use." In cases where accidents might have been averted by the use of improved appliances, etc., which the company failed to provide, little trouble will be experienced in fixing responsibility, and there is no doubt that, acting under the instructions already referred to, offending corporations will be brought to account by the Jersey jurymen. But there are other and far more significant remarks in Judge Depue's charge. He says:

If motormen in charge of cars occasioning death are personally guilty of criminal negligence they may be indicted. But this remedy is partial and inadequate. These persons are employes of the company, running their cars on schedule time. If they fail to make their trips within the scheduled time they are liable to be discharged from employment. The only remedy that is adequate and will be efficacious is against the companies operating these roads. It is unfair to lay upon employes, who are subject to orders and are required to obey orders, the responsibility exclusively of public wrongs which are the product of the management of the roads by the company and its officers. Any use of the streets by these companies which imperils the safety of persons lawfully using the streets, whether the danger arise from an unreasonable degree of speed or from a defective or imperfect construction of the motors or the absence of fenders or guards which might contribute to the safety of others, is a public nuisance and indictable as such.

It is to be hoped that this statement, reflecting as it does on managers of street railway companies, will be proved unwarranted and without foundation; but if these companies have been guilty of violation of the law they should be held strictly accountable.

IN an address on "The Gas Industry in the United States" delivered before the German Society of Gas and Hydraulic Engineers on June 18, 1894, and appearing in English in *Light, Heat and Power*, Herr von Oechelhauser makes some interesting comments on the American electric lighting industry. In this country, he asserts, "there can be found neither as large gas works as in England nor as extensive and beautiful electric central stations as in Germany." This condition of affairs is attributed to the greater number of competing central station companies in the cities of the United States—whereas in Europe "the usual thing is for one company, or indeed for the municipal authorities themselves, to monopolize the whole gas or electric supply of the place"—and to the marked disposition to establish private electrical installations in buildings that would otherwise demand a large proportion of the product of the central stations. As an example of the manner in which private plants supplant the need for central station service, Herr von Oechelhauser mentions what is undoubtedly the largest isolated electric lighting installation in the United States, the plant at the Auditorium in Chicago, which, he remarks, is nearly equal to the Düsseldorf electric works in extent.

It is of no great importance, of course, whether Germany or the United States has the larger central stations for electric lighting, but we are, nevertheless, disposed to question the accuracy of Herr von Oechelhauser's comparison. Take five large lighting stations in the United States —the Pearl street station, New York; Harrison street, Chicago; Municipal, St. Louis, and the great Edison stations in Boston and Philadelphia—and we very much doubt whether five German central station plants of equal capacity can be cited. The Chicago station alone, which has just been placed in operation and has not yet received all of its equipment, will have a capacity of 7,500 kilowatts and is surely a very large station—probably the equal, at least, of any in Germany. To make a general characterization of the United States as a country of comparatively small central stations is therefore inaccurate.

Herr von Oechelhauser takes an optimistic view of both the electrical and gas industries in the United States, although he does not find the financial returns from the central station electrical companies to be flattering. "But," he adds, "owing to the fact, already alluded to above, that American consumers of electric light depend more on local installations or branch establishments than on central stations for their supplies of electricity, the general development of the electrical industry is scarcely, if at all, affected by the smallness of the dividends of the central supply companies, but steadily and surely advances and grows." In considering the relative importance of private plants and central stations, it is interesting to note that, despite the claim of larger central stations for Germany, German statisticians show that but 25 per cent. of the incandescent lamps in that country are supplied with current from central stations. Indeed, the surprising statement is made, in a foot-note to Herr von Oechelhauser's address, that the German city using the largest number of electrical lamps in proportion to its population (Leipsic) has no central station supply of electricity whatever.

## Subdivision and Distribution of Artificial Sources of Light.[1]

NELSON W. PERRY: I would like to ask in regard to the statement that no 450 watt lamp will give, when surrounded by a plain glass globe, 500 candles, what it means? There have been so many thousand measurements of the intensity of arc lamps that have almost universally shown an intensity in the plane of maximum illumination between 750 and 1250 and even more, that it would seem that they could not all be wrong. Most of these measurements were made with lamps without globes, probably. Now, if we assume 1,000 candle power as an average of all of these determinations without globes, we must assume that Prof. Anthony's statement if true must mean that clear glass globes cut off at least 50 per cent. of the light in order to bring it down to 500. This of course is absurd.

PROF. ANTHONY: I think you misunderstood the statement there. The statement is in the direction of the most distant point to be illuminated.

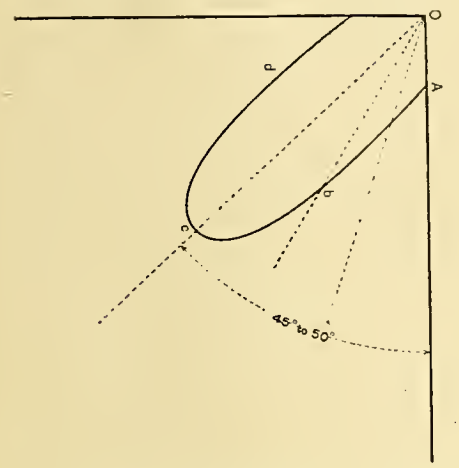



FIG. 1. SUBDIVISION AND DISTRIBUTION OF ARTIFICIAL SOURCES OF LIGHT.

PRESIDENT HOUSTON: Is that made by the short arc or the long arc?

PROF. ANTHONY: The long arc 450 watt lamp. That is in the direction of the farthest point to be illuminated. It would be not more than ten degrees from the horizontal line. The illumination of any arc lamp in that direction is very small.

MR. KENNELLY: While the figures that Prof. Anthony gives are no doubt true in the open air, without moon or star light, that is to say where there is no reflection, yet within doors the circumstances of reflection from walls and ceilings, would so far modify the practical conditions of the problem, that the conclusions to be drawn from the paper will surely undergo great modification in consequence; and while no doubt the general proposition is true that to get the most uniform and the least minimum illumination at any point, you should place a thousand candles in 1,000 candles and not have it in one lamp, still the effect of reflection from walls and ceilings, will so far modify any preconceived notions that we may have upon what should be the best luminous distribution, that everything would largely depend upon the particular circumstances of each case.

THE PRESIDENT: I must confess to considerable surprise at the figures reached by Prof. Anthony. I do not doubt but that as a careful scientific man he has the facts of actual measurement to warrant the correctness of these conclusions. I would say, though, that such a very small economy of light for an arc lamp is quite at variance with the experience I have had in the matter, and is absolutely inconsistent with our ideas of the relations existing between temperatures and the power of emitting light. The temperature of an arc is immensely higher than that of an incandescent filament at any temperature at which it would be practicable to run the filament, and to get so astoundingly small an economy out of an arc lamp shows that there must be either some peculiarity of measurement, or something wrong in our preconceived ideas as to the relation which ought to exist between candle power and temperature. I do not think it fair to measure the light giving power of an arc in a horizontal direction and base conclusions on that. It is fair enough to take that in an ordinary gas flame or in an incandescent light where this direction is far from being its position of least efficiency. I do not think it is fair to take it in the case of an arc light. I was particularly induced to ask whether you were running with the long arc or the small arc since it struck me at first that possibly the error might come from the shading of the positive crater by the projection or nipple on the negative carbon. The figures surprise me very much. I feel sure that it will be quite a surprise to those interested in arc lighting in the country to learn, if I am correct in my understanding, that you do not get more than one and one-half times out of the arc than out of the incandescent. Still, if true, it is very well worth learning.

MR. STEINMETZ: I think the figures are not very far from true. When the 2,000 candle power arc light got this name, it was given to it because if everything is adjusted carefully, as it can be done in the laboratory, then the maximum intensity is about 2,000 candles, but the spherical intensity is only little more than one-third as high, that is, 700 candles, and taking into consideration, that a part of the light is shaded off by the glass globe, we get not very far from 500 candles as the mean intensity of the covered arc. Still from another side you can approach the same result. The brilliancy of the arc is that of boiling carbon. The brilliancy of the incandescent lamp filament, that is, the candles per watt, is less. But, increasing the temperature by raising the voltage, increases the brilliancy, until the carbon filament evaporates. Now, immediately before this, the brilliancy must be about the same as that of the arc. Photometric tests of incandescent lamps at seven to eight times their rated candle power give brilliancies of from 1 to 1.2 candles per watt, and seem to point toward a maximum value of about 1 ½ candle power per watt. The spherical brilliancy of very large arcs was observed as 1.5 to 1.7 candles per watt. The foregoing data of 2,000 maximum or 700 spherical candles for the ordinary 450 watt arc gives a brilliancy of 1.55 candles per watt, so that, estimating the light absorption of the glass globe as 30 per cent. we get the figures given by Prof. Anthony. Hence the name "2,000 candle power arc" only refers to the maximum intensity of the naked arc in the most favorable direction. A more proper way to rate arc lamps would be, not by the candle power, but by the watts consumed. I think that is quite extensively done now.

CLAYTON W. PIKE: I understand Prof. Anthony's figures are about 500 candles spherical when the glass globe is on. I remember making a number of experiments on 1,200 candle power lights without any globe, of the spherical intensity, and in every case we ran below 450 candles. If we change from the 1,200 to the 2,000 and also bring in the correction for loss from the globe, we shall find those figures correspond very closely with Prof. Anthony's. I have done that on a sufficient number of arc lights to enable me to feel sure that those figures are correct.

PROF. ANTHONY: Measuring the intensity of the light from an arc lamp at various angles from the horizontal downward, we obtained results which when plotted on a system of polar co-ordinates gives a curve like *A*, *b*, *c*, *d*, where *O A*, *O b*, *O c*, etc., in Fig. 1 represent the intensities in those directions. The maximum intensity occurs at 45 or 50 degrees below the horizontal, and from that point toward the horizontal it decreases very rapidly, until along the horizontal the 450 watt arc will rarely measure more than 300 candles. It is usual to take as the mean intensity of the arc light the mean intensity in the lower hemisphere, because it is the lower hemisphere that we wish to illuminate in all ordinary use of the lamp. Since the light in the upper hemisphere is extremely small, the mean intensity for the lower hemisphere is much greater than the mean intensity for the entire sphere, but even in the lower hemisphere the mean intensity is not above 500 candles.

THE PRESIDENT: At what height did you estimate the average height of the arc?

PROF. ANTHONY: These are candle power measurements made on a photometer. The horizontal intensity would be a horizontal line.

THE PRESIDENT: You are not considering then the question of illumination at all?

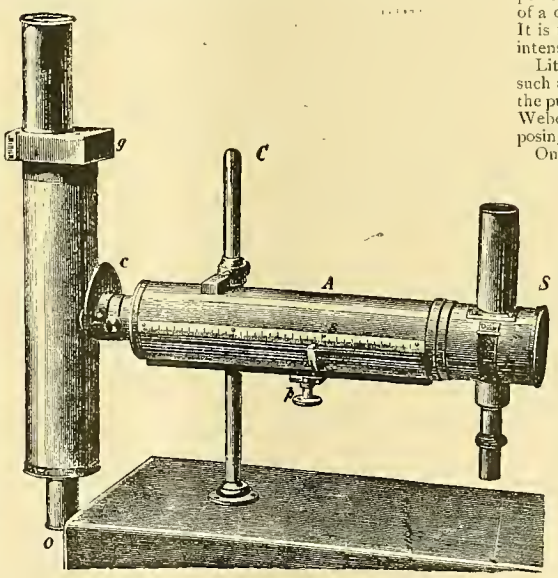



FIG. 2. SUBDIVISION AND DISTRIBUTION OF ARTIFICIAL SOURCES OF LIGHT (ONE-SIXTH ACTUAL SIZE).

PROF. ANTHONY: In this case, in determining the candle power, we simply measure it on a horizontal line as so many candles, and so on as you go down. At 45 or 50 degrees there is a maximum, and the measurements will sometimes run to 1,500 or 1,700 candles. On good 450 watt long arc lamps I never obtained but one measurement out of thousands I have made, as high as 2,000 candles.

FRANCIS R. UPTON: There is one point in distribution which I have noticed, which probably many of you have observed; that is, the fact, that in the illumination of a given space, the whole aim should be not to spot the lighting, so that the eye will not lose its sensitiveness by being dazzled by a bright spot. It is well known to those who have to do with lighting, especially with the incandescent lamp, that rooms can vary two or three-fold in their rate of illumination; that is—the absolute rate of illumination without being noticed—if the eye has only darkness to compare the light with. I feel that there is great room for some good means for determining illumination in distinction from determining the candle power of the light-giving body. There appears to be no good unit for illumination that is thoroughly reliable for this purpose.

THE PRESIDENT: I suppose the photometer you used absolutely prevented any reflection from the ground. You simply measured the horizontal ray. You had probably a shield or screen or something to prevent any other light from coming in except from that direction.

PROF. ANTHONY: Those measurements such as I have shown on the board are made in the photometer room—a blackened room.

THE PRESIDENT: Consequently you would lose all possible advantage of what you get in actual practice—illumination of objects from light thrown from the ground. I cannot believe in only one and a half times the efficiency of the arc light over the incandescent. I think there is something wrong in the method.

R. O. HENIRICH: It is rather surprising that so little attention has been paid to the very important and eminently practical questions considered by Prof. Anthony. If we would simply make a distinction between luminosity of a sourse and illumination produced, such perplexing questions as the actual candle power of a "2,000-candle power" arc would be of very minor importance. On account of the Complication of conditions the illuminating effect of a combination of sources of light, such as met with for artificial

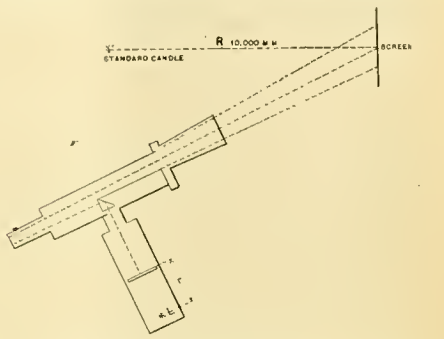



FIG. 3. SUBDIVISION AND DISTRIBUTION OF ARTIFICIAL SOURCES OF LIGHT.

illumination, is almost beyond mathematical computation. A practical and successful solution of such problems can be obtained only through a vast number of observations and measurements.

The requirements of actual practice are two-fold: First, a uniform illumination should be attained, one which comes nearest to the ideal illumination of diffused daylight; second, a definite intensity of illumination should be assumed as necessary either for the performance of certain work, such as reading, writing, drawing, sewing, etc.; for general indoor illumination in theaters, halls, etc., and for outdoor and street illumination.

It matters little for these considerations what the "candle-power" of a source of light amounts to; for the conception of a definite illumination, this expression is without meaning. It is necessary under these considerations to express the intensity of illumination in its own distinct unit.

Little has been done toward the universal adoption of such a unit, although the "meter candle" was proposed for the purpose more than ten years ago by Prof. Leonhard Weber, W. H. Preece and Mr. Wybauw, the latter proposing the name "lux" for this unit.

On the authority of Dr. H. Cohn Breslau, 50 meter candles are sufficient to permit reading with the same facility as in diffused daylight. He considers 10 meter candles as a minimum illumination from a hygienic standpoint, for the purpose of reading. Wybauw (Mésure et répartition de l'eclairement, *Bull. de la Soc. Belge d'Electr.*, 1885) considers 15 to 25 meter candles or "lux" as necessary to permit a fluent and prolonged reading of a newspaper and holds that a minimum of one meter candle should be required for street illumination.

Assuming such or similar values based upon a unit of illumination, all controversy as to candle powers would be at an end. Contracts for the illumination of reading rooms, halls, streets, squares, etc., should specify a required minimum illumination in some such unit and it would then rest with the expert engineer to accomplish this with the least possible amount of mechanical energy converted into light.

Actual measurements would soon convince us in what bungling way illumination is generally carried out. Prof. Anthony's remarks in reference to the lighting of pretentious country villages and suburban places are very pertinent; they would apply equally well to the illumination of our city streets and squares if it were not for the illuminated shop windows which somewhat mitigate the contrast between super-abundance of light and darkness.

In connection with this matter I may be allowed to make reference to Prof. L. Weber's portable photometer, which is especially adapted for making measurements of the intensity of illumination. This photometer seems little known on this side of the Atlantic and I therefore give a sketch of its general arrangement in Figs. 2 and 3.

The apparatus consists of a tube *A* about 30 centimeters long, which can be moved up and down, and swung in a horizontal plane on the upright *C*. The standard light *S*, a benzine lamp, is contained in a lantern fastened to the right end of the tube *A*. Within the tube *A* a circular plate of opal glass can be moved from or toward the light *S*; its distance from *S* is read in centimeters on the scale *S* by means of an index fastened to the pinion *P*. At right angle to tube *A* a second tube *B* is fastened. This tube can be rotated in a vertical plane, and its position in reference to the horizontal is read on the graduated circle *C*. A rectangular prism contained in tube *B* in its axis of rotation receives light from the opal glass plate in tube *A* and reflects this light towards the eye piece *O*, so that the right half of the field of vision is illuminated by this light, the left half is illuminated by the light entering the tube *B* at *g*.

In making measurements, the tube *B* is pointed toward the source of light to be measured. This light has to pass through a square box *g* in which may be inserted one or

1. Discussion of Prof. W. A. Anthony's paper read before the American Institute of Electrical Engineers, Philadelphia, May 15, 1894, and printed in the WESTERN ELECTRICIAN June 2, 1894.

more opal glass plates, in order to diminish the intensity of the light and thus to make it comparable with the standard light. The apparatus permits the measurement of light in the shape of a flame as well as the measurement of diffused light.

Since the measurement of diffused light interests us most at present, a short description of the method will not be out of place. A white screen, the surface of which is absolutely without lustre, furnished as part of the apparatus, is placed in a convenient position, either horizontal or vertical, or at any desired inclination toward the source of light. The photometer having been located at a convenient distance from the screen, the tube *B* is pointed to the center of the screen. The distance of the photometer from the screen can be varied within very wide limits, the only restrictions being that the field of vision receives no other light than that emanating from the screen. The necessary precautions for adjustment having been observed, the opal glass plate in tube *A* is moved until both halves of the field of vision appear equally illuminated. The distance *r* of this glass plate from the standard light at the moment of equal illumination is read on the scale on tube *A* in millimetres, and the intensity of illumination on the white screen is calculated from the formula

$$I = \frac{10000}{r^2} K$$

The constant K is previously determined as follows: A standard candle is placed exactly one meter distant from the white screen and the tube *B* of the photometer is pointed toward the screen, so that the center of the screen, which is marked by a cross, is seen in the center of the field of vision. As indicated in the sketch, the photometer must be so placed that the eye looking through the eyepiece sees nothing but the white screen. The angle of inclination under which the screen is observed may be varied within wide limits without influencing the result; it should, however, not exceed 60° from the normal to the screen.

Equal illumination of both halves of the field of vision having been obtained by means of adjusting the opal glass plate in tube *A*, the constant *C* is found by calculation:

$$K = \frac{r^2}{R^2}.$$

Since r is read in millimeters and R is made 1 meter or 10,000 millimeters, 10,000 instead of 1 must be taken in the formula for calculating the intensity of illumination in meter candles.

A second method permits of measurements of diffused light without the intervention of the screen, but for further details I must refer to the description of the apparatus by Prof. Weber, *Elektrotechnische Zeitschrift*, vol. v., p. 166.

Since the whole apparatus can easily be taken apart and packed in a box about 24 by 8 by 12 inches, it recommends itself extremely well for out-of-door work. In this case the benzine lamp might well be replaced by a small incandescent lamp, provided this lamp is standardized before and after each set of experiments. I have found such miniature lamps very convenient, and quite sufficiently constant in candle power for several hundred observations.

## Electric Street Railway Ambulance at St. Louis.

Several years ago Health Commissioner Dr. George Homan of St. Louis advocated the employment of an electric street railway ambulance, and a bill was brought before the Municipal Assembly of St. Louis last winter authorizing the establishment of such service. The bill, however, failed to pass, and the matter was dropped for the time being. A few weeks ago Dr. Homan took the matter up again and this time brought it before President Scullin of the Union Depot Street Railroad company. President Scullin soon agreed with Health Commissioner Homan that the plan was entirely practicable and agreed to have an ambulance car built especially for the purpose. An order was given to build the car and to arrange the interior, doors and platforms according to Dr. Homan's plans.

The car is now being built by the St. Louis Car company and will be complete in every detail. It will, in fact, be a complete traveling hospital. The line of service will be from Twelfth and Pine streets, over the line of the Union Depot street railroad to the City Hospital and the western terminus at King's highway and Arsenal street, where patients will be transferred by ordinary ambulances to the Female Hospital, a fourth of a mile distant, and also to other institutions in that vicinity.

In the meantime an ordinary car is being used for this service. This car is fitted up temporarily for the purpose, and is in charge of a physician with an attendant and motorman and runs on a regular schedule, making seven trips daily, three of which are through trips to the western terminus. The car is handling from fifty to sixty patients daily. The Sunday schedule provides for five trips, two of which are through.

## Underground Wires in Boston.

Noting the progress in burying the street electrical wires of Boston, the *Traveller* of that city says: The tremendous task of placing Boston's overhead wires under ground is proceeding rapidly and smoothly under the direction of Commissioner Murphy. Five weeks of the hardest kind of hard work by Mr. Murphy and his assistants have been devoted to consultation with the electric companies, the arranging of plans and all the numerous details incidental to the work of removing the wires in the section of the city laid out for this year. There is no truth in the report that difficulty was encountered by the wire commissioner in the matter of placing under ground the West End railway wires. On Thursday Mr. Murphy made application to Superintendent of Streets Carter for a permit for the West End company to lay its wires in Essex street across Washington to Boylston as far as Tremont. He suggested that both the West End and New England telephone wires be laid in the same trench while crossing Washington street, with a double set of manholes. Application to Superintendent Carter was also made to lay wires on Albany and Kingston streets, Broadway and Lehigh street. The West End has not received its permit yet, but will probably receive it the first of the week, when the work will be immediately commenced. Similar applications for permits have been made for the New England Telephone and Boston Electric companies. Arrangements with the Western Union company will probably be made soon. It has been suggested that auxiliary fire alarm companies petition the fire commissioners for leave to lay their wires in the ducts with the fire alarm wires. There are about 35 small companies using perhaps a wire or two apiece, and the commissioner has directed his best efforts to have them place their wires in one common duct. Mr. Murphy says: "There has been no friction caused by anyone in this work. There has been a strong unanimity of purpose in the different interests concerned to do all that was possible in carrying out the strict particulars of the law. The time has been very short for the amount of work done and the labor severe, but the work as laid out will be done and every wire in the section laid out will be under ground by the end of the year." A month has been devoted to looking over plans, altering and amending them to the mutual satisfaction of the wire commissioner and the companies concerned. These plans are almost all finished now and the wires will commence to come down very speedily.

## Electrolysis of Water Mains.[1]

By G. H. Benzenberg.

Since the last meeting of this association the subject of corrosion and the destruction of water mains, gas and service pipes, cables and other underground conductors in streets where electricity has been introduced as the railway motive power has, at the hands of the various engineers and the chemists, received a much more scrutinizing and scientific consideration, by closer investigation or by experiments and laboratory tests; and thereby much of the mystery which seemed to surround this destructive process some twelve months ago has been removed. The doubt which seemed to exist in the minds of many as to the corrosive action occurring only at such points where the current left the enforced conductor has been entirely removed, and the fact established that only where the pipe or cable is positive to the earth and to some other conductor, and where the pipe or cable assumes the position of an anode to that other conductor, be it the rail, some other pipe or cable, or the generator itself as the cathode, with the intervening earth as the electrolyte, that corrosion takes place by electrolytic action. It has also been established in experiment by more than one investigator that it needs but an extremely low potential, not exceeding one hundredth of a volt, coupled with other favorable conditions, to produce electrolytic action, though it may take considerable time to cause the results to become apparent.

During this time, also, information has been received from many additional cases where injury to water mains, service pipes or cables has been reported. The investigation of some of these injuries was placed in the hands of electrical experts or commissions, whose reports thereon have been published from time to time in some of the technical publications. All of these reports agree with the views held heretofore, that the trouble is caused by the imperfect means provided by the electric street railway companies for the return of the current, and suggest sundry improvements upon the methods employed to return this current, from the double overhead trolley system or the continuous perfectly insulated underground cable return to the various methods of bonding the rails and the use of an ordinary continuous return wire connected with the rails. Of these methods, undoubtedly the first two, while in perfect condition, would afford the most complete protection; but there are sufficient serious objections to them on the part of the street railway companies to prevent their being adopted, and the remedies, therefore, must be sought along the line of more reasonable requirements and against which the companies cannot sustain valid objections. By this statement it is not meant that it should be inferred that the electric railway companies should not be held to provide for positively adequate means of returning the current to the generator without damage to other property, but that, if such object can be accomplished by other more moderate and suitable means, the companies, who are deeply interested in the return of the current at as high a potential as possible, will undoubtedly more readily provide the means of protection.

The rails, which in the first instance receive the return current, unquestionably possess, if of ample section and without a joint, a sufficient conductivity to return all the current to the generator, excepting what in any case, under the law of divided circuits, is certain to escape to other conductors, if such exist. Therefore, all that is necessary to obtain the most perfect uninsulated and available conductor is to reduce all possible resistance at the rail ends by providing a most perfect bond between them, equal to the rail in conductivity, or, in other words, by rivetting a copper bond of about twelve inches length to the rail ends, the section or number of these bonds to increase as the power house is being approached, supplemented by similar cross bonds, connecting the four rails to each other every 100 to 120 feet. These rail-bonds should in section or number anticipate increase in traffic and extensions. If a number of railway lines are operated from one power house, and particularly if the power house is not on the line of the railway, ample return feeders should radiate out to the various centers so as to relieve the overloaded rails, and these return feeders should be well insulated to preserve them and also to prevent leakages to the ground.

[1]. Report of the committee on electrolysis at the recent convention of the American Water Works association.

However, even with such careful and ample provision for the return current through the rails and insulated return feed wires or cables, a certain percentage of the current is, especially in moist earths, bound to leak through it to some other conductor, and the amount thereof will depend upon the combined resistance of the earth and conductor compared to that of the rail or other return circuit. If this amount does not increase to such an extent as to make this conducting medium, be it water, gas-pipe or cable, at any point, positive to either the rail or any other conducting medium, so as to cause the current to leave it, there would be no harm done, providing the conductivity of the pipe were uniform throughout and made continuous to the generator by an ample and perfect connection at some suitable point. With a proper bonded rail circuit, reinforced by insulated return wires or cables from central points, such increase of current on any water pipe is not easily possible, as the resistance offered by the water pipe is very low, the metallic section of a six-inch water pipe being one and one-half time that of a 70 pound rail, while that of an eight-inch pipe is two and one-quarter and of a twelve inch pipe three and three-quarters times as great; therefore, the perfecting of the circuit from the pipe to the generator in such cases is generally sufficient provision to protect the water pipe from electrolytic action.

But in all cases where the resistance to the current in the rails has not been reduced to a minimum, the proportion of the leakage becomes greater, and, where the bonding is poor or imperfect, the resistance in the rail circuit becomes so great as to cause the water pipe to become the main return feeeder, if not along the entire line, at least in many sections, and thus the pipe at many points becomes positive to adjacent or parallel conductors, at once establishing conditions which will produce electrolytic action, the extent of the destructiveness of which to the pipe will depend upon the low resistance offered by the earth and upon the amount of soluble salts, the electrolysis of which is injurious to the iron, that are contained therein. These salts, according to extensive experiments made by Prof. D. C. Jackson of the University of Wisconsin and reported by him in a paper read before the Western Society of Engineers, consist of chlorides, nitrates and sulphates, given in the order of the effect of their activity upon the iron pipe when acted upon by the electric current; a mixture of these salts causing intermediate results. These salts in some one form or another are to be found to a greater or lesser extent in almost every street soil and, as Prof. Jackson has demonstrated, "only a minute quantity of soluble salt is sufficient to start action, and it will then continue as long as a current flows." It is clear, therefore, that the conditions are favorable to the corrosion of the pipe. Again, quoting from Prof. Jackson's most valuable paper on this subject: "The problem of preventing the destructive electrolytic effects upon the pipes of the railway return current is shown to consist simply of the prevention of electrolysis of the salts of the soil, when the products of electrolysis are of such a nature as to attack iron."

To accomplish this it is but necessary to prevent the pipe at any point from becoming positive to the rail or any other possible conductor. Whether the pipe is positive or not can be easily determined by a few observations with a voltameter at points radiating out from the power house and along the line, where, by a perceptible difference in the potential between rails, the existence of poor or defective rail-bonds is shown. This fact and the points where the pipe is positive having been determined, the railway company should not lose a moment to re-establish the proper conditions for the protection of the pipe.

If not already provided, ample and suitable connection by an insulated cable should at once be made between the pipe and the generator to afford the least resistance for the proper escape of the current to its destination. If this has already been supplied and if the pipe is still positive, the rail-bonds at such points should be perfected and, if the conditions are such that an increase of the section or number of such bonds will not entirely remove the difficulty, proper and suitable metallic connections should be made at such places between the pipe and rail so as to permit the return of the current to the rail, until the proper equilibrium, dependent upon the relative resistance, has been established without the necessity of passing the current through an electrolyte and of developing electrolytic action in the accomplishment of such result. Insufficient rail section, inadequate return feeders or especially wet soil, presenting an easy avenue for the current to reach the pipe, may make it necessary to add to the number of such connections, but they should only be made where the pipe is positive in order to relieve the pipe and for no other purposes. If this method be followed, no damage, it seems, can arise to the pipe, but, to the contrary, the best possible protection given it against an agent whose permeating power it is impossible entirely to escape.

The only question which may arise in connection herewith is as to the uniform conductivity of the pipe, whether there is sufficient resistance in the lead joints to cause some of the current to pass around and in doing so produce electrolytic action. In a measurement made on August 9, 1894, at the lead joint of an eight inch water main in front of the power house of the Milwaukee Street Railway company, through which main 16 per cent. of the entire output of the station (or 421 amperes) is being returned (31 per cent. being the entire amount returned through the water mains), a drop of potential of but .0198 volt was found to exist between the ends of the pipe, indicating a resistance of .000047 ohm, certainly not sufficient to produce electrolysis even with the most favorable conditions existing at the joint.

But, do any favorable conditions exist? Professor Jackson, by his great number of experiments, has established that "in no case is the (corrosive) action due to the electrolysis of water; where oxygen is liberated at the anode, it does not attack the iron;" and again: "In order to have the first electrolytic process go on (that is, direct electrolysis of iron), a soluble iron salt must be present in the soil, reaching from anode to cathode. The analysis of street soils shows no such salts." Corrosion at the joints, therefore, can only be caused by the electrolysis of the soluble salts heretofore mentioned, if they exist between the hub end and the adjoin-

ing pipe at the joint. A most careful examination of the pipes and the lead joint in the eight inch main above referred to did not show the least perceptible action or corrosion, although the main had been used as a conductor for years. It does not seem, therefore, that there is the least cause for any anxiety that corrosive electrolytic action may take place at the lead joints and, hence, a water main of like diameter may safely be considered to possess a uniform conductivity throughout and capable of conducting without injury so much of the current as under the law of divided circuits it cannot avoid conveying.

The eight inch water pipe, where the same is connected by a 500,000 circular mil cable to the generator, was subjected, on either side of the connection and under the clamps, to a most careful scrutiny and examination, but, notwithstanding the clamp and cable had not been touched for fifteen months, not even the least discernible change could be detected at any point. Where the iron pipe had been filed to form a contact with the clamp, the fine markings of the file were as sharp and distinct as on the day they were made. Other connections between the rails and pipe which were examined were found to be in equally good condition, and all possible information obtained so far indicates that all corrosive electrolytic action on or along the pipes has been arrested.

Undoubtedly, electric street railway companies will soon, if they have not already, learn to appreciate the economy stored in a perfect return circuit of least possible resistance, and perfect, by improved copper bonds and return cable feeders, their present in many instances inadequate system.

The line of inquiry and investigation for the water works engineer to pursue and the remedy, if needed, to be demanded at the hands of the railway company have been made clear at least by the investigations and experiments which have been made; and he can now by his own observations ascertain whether or not any part of his pipe system is endangered.

## Electric Locomotives.

In announcing the forthcoming trial of the electric locomotive made for use in the Baltimore tunnel, the *Railroad Gazette* makes the following editorial comment:

The time is not far distant when some of the speculative matters in the field of application of electricity to elevated and trunk line railroads will be brought to a practical test. The large motor for the Baltimore & Ohio railroad is nearly completed at the General Electric company's works in Schenectady. The design differs somewhat in size from the original as illustrated in the *Railroad Gazette*, as there will now be but eight wheels instead of twelve as originally intended. It will be remembered that the motor was to consist of three four-wheeled motors or "units" coupled by a drawbar and acting together, the current for all being controlled by one central controller on the middle motor. Construction of all the motors has not been carried along together, but one has been brought nearly to completion in order to give time for experiment. It has been found that the power of the electric motor on this one unit is more than sufficient to do safely the work laid out originally, and that there is margin enough to permit an increase of the weight of the single units so that two of them will do the work. Thus the locomotive becomes an eight-wheeler instead of a twelve-wheeler, these terms being used in the strict sense and not to indicate what is known in steam locomotive vernacular as "eight-wheelers" and "twelve-wheelers," for such engines have trucks and these have not.

While it is known now that the power of these motors will be sufficient to pull, or rather to push (for that is what they are intended to do), a locomotive and 30 freight cars at 15 miles an hour, or a locomotive and 10 passenger cars at 30 miles an hour, up the grade of the Baltimore & Ohio tunnel, yet the reliance that can be placed upon them for everyday work will be in question until there is an actual trial. A short time since there was a test between one of these units and a heavy six-wheel switching locomotive at Schenectady. The result was quite different from the "tug-of-war" test at the World's Fair, for the reason that certain precautions had been taken which were neglected at the tug-of-war. The reasons for the failure of the World's Fair tests are found in an editorial in the *Railroad Gazette* of October 6, 1893, page 734. At the Schenectady test the electric locomotive pulled the steam locomotive with perfect ease, and without any apparent effort, although the motor was without parallel rods and only the clutches on one side were connected. This test showed two important things: First, that the motor had the power that was expected of it, and, second, that the driving mechanism and clutches, which are of a new and unique design, were strong enough to transmit the enormous twist, or "torque" as it is called, of the armature.

The finishing of these motors was put off because the tunnel was not complete, and this is fortunate perhaps because during the interval there have been several important improvements in electrical devices which will now be incorporated in these machines. The power house construction at Baltimore is being pushed and it is hoped that these motors will be in operation before the 1st of February. There have been rumors of the intended use of motors of this size for the St. Clair tunnel, the Kicking Horse grade of the Canadian Pacific, the Illinois Central and the Hoosac Tunnel, but so far as can be learned no definite steps have been taken toward construction, and matters seem to be waiting for the result of the Baltimore & Ohio experiments.

The Metropolitan elevated road in Chicago is the field which promises a development next in importance to the Baltimore & Ohio. There are about eight miles of this road now constructed. The bridge over the Chicago river is being pushed rapidly, the electric power house will soon be done and the generating apparatus in position. Some of the motors are now completed at Schenectady in the shops of the General Electric company and will be ready for the trucks in a short time.

In some respects the plan of equipping this road comes nearer to the ultimate method that has been outlined by the makers of electrical apparatus than might have been expected so early in the development of the use of electricity for large roads. The makers of electrical apparatus have always claimed that the time would come when railroad companies would buy electric motors just as they now buy a set of driving wheels or any other detail of a locomotive, and would have the wheels, cabs, brakes and other apparatus built from their own designs and in their own shops, or by regular locomotive builders, and the electrical apparatus would be put on as a rather simple and unimportant part of the machine. This is pretty nearly what the officers of the Metropolitan road have done. They have ordered their motor cars and trucks from their own designs, and have simply purchased electric motors and controllers from the makers of electrical apparatus. A plan of the motors and the general dimensions were furnished to the road and they built the trucks to suit.

These motor cars will carry passengers and be quite powerful enough to haul five other cars. There will be one four-wheel truck at each end with one motor on each axle, thus making four motors in all, the combined power of which will be considerably greater than the most powerful steam locomotives used in elevated service. The outward appearance of these trains will be like a five or six-car train on the Manhattan without any locomotives; and except for the controller, which will be enclosed in a box, there will be nothing above the floor to indicate that there is any more driving mechanism than on an ordinary cable car. It is expected that the motor cars will weigh about 60,000 pounds, and thus they will be capable of hauling a train more than one-half heavier than the steam locomotives on the Alley Elevated, which are the largest now in use in elevated service.

The trains will be equipped with the Westinghouse automatic air-brake, the air being supplied by an electric air pump, the design of which is not yet settled upon. They will be lighted by electricity and perhaps heated in that way. The equipment has many of the elements of what would be pronounced by some as the ultimate plan now in view, and this makes the Metropolitan Elevated an interesting subject of discussion now and worth watching in the future.

With these two large projects nearing completion so as to be in active operation at the end of six months, next year promises to be one in which will be settled some of the disputed points about the adaptability of electric motors for railroads, and it may be expected that some of the interesting questions that have been asked relative to economies and efficiencies will not long remain unanswered.

## Some Storage Battery Phenomena.[1]

DR. LOUIS DUNCAN: In a paper which I had the pleasure of reading before the Institute some years ago, I described some experiments on some of the points brought out by Mr. Griscom, and I would like to say a few words about them. In the first place, with respect to the local action taking place in the plates. Mr. Weigand and myself made some investigation on this point and found that the local action between parts of the same plate was very considerable under certain conditions. We found that when the cell had been very heavily discharged, that the chemical condition of different parts of a plug of active material was different and a local action took place, which tended to make the plug uniform in its constitution and this accounted for a part of the increased loss of energy when the discharge rate in a battery was high. Again I see that Mr. Griscom states that Prof. Ayrton discovered the cooling of a storage cell on its being discharged. Mr. Griscom could not have read Prof. Ayrton's paper carefully or he would have noticed that Prof. Ayrton himself attributes this discovery to myself and Mr. Weigand. We tried to explain the cooling effect by the taking of sulphuric acid from the solution, but this did not account for all of the cooling and there must be some other cause for it. There is a considerable amount of energy given to a cell which is never given back again, but which results in the formation of compounds which are not reversed on discharge.

I see that Mr. Griscom states that the theory held by some people that the decrease of the porosity of the plugs changes the resistance of the cell is untenable. In the paper by Mr. Weigand and myself, to which I have referred, we made some experiments on the porosity of plugs, both when completely charged and when discharged, and we found that they were much more porous when charged. We wanted to find why it is that a high rate of discharge is injurious to the battery, especially if it has been partly discharged, and also why the electromotive force of a cell drops faster when a battery is partly discharged than when it is fully charged. We found that when the discharge rate is rapid, acid is taken from the solution inside of the plug, thus, of course, weakening the solution, which only gains acid again by diffusion from the outside. The diffusion decreases greatly as the battery becomes discharged, and when a certain strength of current is taken from it, the acid in the plug becomes greatly impoverished, and a phenomenon occurs which is mentioned by Gladstone and Tribe in their work on the storage battery. They found that when the solution reached a certain dilution the chemical action on the lead plates changed and a different compound than peroxide of lead was formed, the plate being rapidly corroded. We came to the conclusion then, from our work, that a large part of the fall of electromotive force and the deterioration of batteries at high discharge rates were due to the weakening of the acid in the plug, and from our experiments on the rate of diffusion in the plug we saw that both of these effects would be exaggerated as the battery was discharged, and the rate of diffusion was lowered. As the chemical action when the battery is partly run down takes place on the inside of the plug, the resistance will naturally be increased both by the greater distance from the support plate and the decreased conductivity of the material through which the current must flow to the support.

There is one thing that seems to be particularly interesting, and that is the fact that plates in the same cell, after the discharge has taken place, will give a current between one another. Although the fact that local action takes place in the plate has been observed before, yet I do not know of any experiments that have been made on the loss of energy due to currents between plates of the same name in the same cell.

There is another very interesting point in the paper, and that is the wonderful phenomenon of automatic discharge described by Mr. Griscom. I have never seen it take place and I am very certain I cannot explain it.

MR. GRISCOM: I would like to correct two misconceptions on the part of Dr. Duncan. I did not say that Ayrton, whose unrivaled researches I have not only read but studied, was the first discoverer of the cooling effect of discharge, but that he independently discovered it and published the first curve showing the history of cooling on discharge. Nor did I mean to convey the impression that the clogging action of discharge had no effect whatever on the resistance of the cell, but that it was not the only influence at work. For the resistance varies in some parts of the charge and discharge in exactly the opposite way from that which would result from the clogging theory.

As to the irreversible electrolytic actions remarked by Drs. Duncan and Weigand, I can only say that I have heard of such actions very often since the Faure discoveries were published, but if the word "irreversible" be used in its absolute sense I have failed to find them—at least during the proper and legitimate use of storage batteries.

SIR DAVID SOLOMONS, London (Communicated): I have been favored with an advance copy of Mr. Griscom's interesting paper, in which he does me the honor of referring to me in regard to one or two matters. I will therefore confine myself to saying a few words on my experience since the time alluded to in the paper.

It is quite true that the glass cells are very apt to crack in the sunlight. At first I thought this must be due to some chemical action upon the glass, but such, it would now appear, is not the case, for empty glass cells crack in the same way. Therefore, I conclude that the cause must be the unequal expansion of the glass, for I was unable to make pots, which had been very carefully annealed, crack in the manner described.

There can be no doubt that the positive plates in a section discharge themselves if left at rest. There appears to be conclusive evidence upon the point. There are two causes for this: First, by the slight leakage which exists in every installation; and, secondly, a leakage in the cell itself apart from any local action which may take place in consequence of the materials employed in building up a section, and this circumstance cannot be avoided, for all substances conduct in a greater or less degree. With due care and by the addition of caustic soda or sulphate of soda, I have been able to reduce the slow discharge in a very great degree. In all cases where the battery is likely to be left at rest for considerable periods, great attention should be given to the materials employed for building up the section. Although this seems to be a common-sense proceeding it is often neglected.

1. Discussion on W. W. Griscom's paper, read before the American Institute of Electrical Engineers, Philadelphia, May 16, 1894, and printed in the WESTERN ELECTRICIAN June 26, 1894.

## Wellington Adams Defeated.

The suit brought in the United States Circuit Court at St. Louis, before Judge Hallett, by the Adams Electric Railway company against the Lindell Railroad company, has been decided in favor of the defendant. The plaintiff sought to recover for infringement of the patent granted to Wellington Adams in 1884, for the application of electric motors to the axles of railway cars. The defendant uses the Sprague-Edison system, and the defense therefore fell to the General Electric company. The case was argued in April last. Had the contention of priority for the Adams patent been upheld every electric railroad company in the country might have been proceeded against. In his opinion the judge said:

None of the elements of the combination described in the claims was new at the date of the application; the motor and its several parts, the car-axle, the axle-boxes, the field-supporting frame and all other things mentioned in the claims were in use before that time. The form of some of the elements was changed in the Adams combination, but it is clear that none of them were new at that time. Upon full examination of the record and the very able arguments of counsel I am not convinced of the merits of the patent.

The Adams company will appeal the case.

## Electricity as a Gambler's Defense.

A raid was recently made on "Billy" Fagan's pool-room on Clark street, Chicago, by a force of constables. It was distinguished from other efforts of this character by the fact that one of the blackboards used for posting the results of the races was "loaded" with electricity. Constable Cerf was in charge of the attacking party, and when he approached the blackboard in question one of the attendants cried out: "Hold on, Cerf, I don't want to see you hurt. That blackboard is loaded; you had better let it alone." The constable paid no attention to this advice, but he had occasion to regret his rashness, for on grasping the edge of the board he received a severe shock, which caused him to recoil in great haste. Later examination revealed the fact that a bare wire ran around the outer rim of the board, and that, by a connection on the back of the board, this wire could be charged with electricity from a concealed battery and induction coil. The switch controlling the circuit was located behind a counter at a little distance, so that the attendant could "load" the board at will without being observed.

Clark Rude has been authorized to build an electric railway in Knoxville, Tenn.

## The Knapp Failure.

The failure of the Knapp Electrical Works continues to furnish a topic for much animated discussion in electrical circles. The liabilities are now said to amount to $100,000, while the available assets are small. The creditors have held a meeting and appointed a committee, with George S. Searing as chairman, to represent them in examining the books. H. P. Lucas is the receiver for the concern.

## National Electric Light Association.

At a meeting of the executive committee of the National Electric Light association at the Hotel Brunswick, New York, Tuesday, September 11th, it was decided that the next convention of the association be held in Cleveland, O., February 19, 20 and 21, 1895.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, September 17.—On Wednesday the directors of the Western Union Telegraph company declared the regular quarterly dividend of 1¼ per cent. The financial statement shows a surplus after charges and dividend of $365,000, against $381,154 in the same quarter of 1893. The net revenues are estimated as equal to last year's quarter, but the charges and dividend requirements were slightly larger. The company deducts from its book surplus $550,000 treasury stock issued for the requisition of the property of the American Rapid Telegraph company, leaving the surplus at $6,822,633. The total outstanding stock now is $95,370,000, and there is left in the treasury $4,629,852 stock to be issued from time to time for new construction or acquisitions. John T. Terry, a prominent Western Union director, said that the Western Union had been paying the American Rapid $60,000 a year rental, but by the purchase it now pays only $27,500 as dividends on the Western Union stock issued for the Rapid company's property. Moreover, the wires were so mixed up with Western Union wires that the company could not have delivered the American Rapid wires if called on to do so by the contract. Over $200,000 has been saved to the Western Union by a court decision in favor of the American Rapid, which was rendered just after the purchase was concluded.

The Commercial Cable company's new cable, which was laid up the bay from Coney Island to Pier A, has been spliced to the main cable off Manhattan Beach. Messages were at once exchanged over the cable between the New York office and the company's station at Canso, N. S. The cable worked perfectly, and the company's officials are highly pleased with the result of bringing the cable direct to the city.

The Drayton divorce suit has directed public attention to the fact that Hallett Alsop Borrowe, who figures so prominently in the case, is now division superintendent of the electric railway line connecting New York and Newark. Once a typical man about town, with no other occupation than killing time, Borrowe is now a salaried employe of the Consolidated Traction company, and is regarded by his superiors as a capable man. In its new power house in that part of Newark known as "The Neck," the company has provided some rough and ready apartments for its unmarried employes. Many conductors and motormen, whose duties keep them out at night, rent rooms in the power house for a nominal sum. In one of these rooms the division superintendent lives and sleeps. Sometimes he breakfasts there, or heats a pot of coffee on his oil stove, like the other employes. Borrowe wears a blue suit of the regulation color of the company's uniforms, and altogether the change in his circumstances is a curious one.

In the suit in the New Jersey Chancery Court for the appointment of a receiver for the North American Phonograph company, John R. Hardin of Newark being made receiver, Thomas A. Edison, the inventor of the phonograph, makes an affidavit in which he gives the history of the company. He says the company for some time did a good business, and its prospects for further success were good, but in a short time it was shown that the instrument as manufactured had little or no practical or commercial value. In 1892 the company had to authorize the issue of bonds to the extent of $300,000, each bond being for $1,000. He held 220 of the bonds, and on May 1, 1894, he wrote and demanded payment of the interest on the bonds. The company was unable to pay it. He at last sold the stock at auction. The property of the company, he says, is not worth over $25,000. W. F. O.

## San Francisco, Cal.

SAN FRANCISCO, September 10.—The recent combination of street railway interests in San Francisco by which the Central Street Railway company, the Ferries and Cliff House Cable company, the Market Street Cable railway, the City railroad, the North Beach & Mission street railway and the Omnibus Cable company, pool their issues forming a new combination known as the Market Street Railway company of San Francisco, is experiencing an unlooked for trouble in effecting the sale of $17,500,000 worth of bonds that the company has issued for the purpose of obtaining money with which to develop and perfect its system. It is proposed to equip all the horse car lines and those cable lines of the system that run on level streets, Market Street alone excepted, with electric equipment, to build new lines and to make the system one of the most complete to be found in the country. The last step has been the purchase of the Metropolitan electric railway by the Market Street company. This road cost about $600,000 and runs from Market street out Eddy to Hyde, to O'Farrell, to Scott, to Fell, to Baker, to Page, to Golden Gate Park with a branch extending around the south side of the park to a side entrance. It is now proposed to carry this extension on to the Cliff House and Ocean Beach, establishing a five-cent fare for the complete ride from ferries to ocean. The hitch referred to has been occasioned by an opinion given by an attorney of prospective bond buyers that the bond issuance is illegal because of the fact that proxies were voted in the meeting of stockholders which determined on the issuance of bonds. The matter will be taken to the Supreme Court by the company and the question settled as soon as possible.

It is interesting to learn from the San Francisco *Chronicle* that the rails of the San Francisco and San Mateo Electric Road which are now being rebonded were formerly in such a condition that "the return current was only secured by such fluid as could be conducted by the rails themselves."

George L. Henzel of the George L. Henzel Electric company, corner of Bush and Steiner streets, San Francisco, has filed a petition to be declared insolvent. His liabilities are figured at $15,670, among which is a note for $2,700 upon which payment has been made until there is a balance now due of $1,600 to his brother, Edward L. Henzel, who conducts an independent wiring business in San Francisco. The assets consist of fixtures and electrical supplies valued at $2,200. They are covered by a chattel mortgage to Mrs. Z. W. Kahler for $800. The property at Bush and Steiner streets is a homestead. It is mortgaged for $10,000. The principal San Francisco creditors are: Huntington, Hopkins & Co., $450; Dunham, Carrigan & Co., $100; J. A Roeblings Co., $419; California Electrical Works, $113; W. W. Montagu & Co., $148; C. F. Doe, $190; Houson's Planing Mill, $275; Clark & Co., $126: Mrs. F. Baldwin, $300; Mrs. Z. W. Kahler, $800; Hibernia Bank, $10,000; E. F. Herzel, $1,150, and the Law Telephone company, New York, $450.

S. F.

## Milwaukee, Wis.

MILWAUKEE, September, 15.—The special committee of the common council appointed to take the preliminary steps for the purchase of the street railway and electric lighting systems of the city held a special meeting recently. Alderman Rauschenberger, the president of the council, who introduced the resolution which resulted in the appointment of the committee, was requested to give his views on the subject. He stated that in case the street railway plant could not be purchased at a reasonable figure, he thought it would be good policy for the city to begin the construction of its own lines, by laying tracks on streets on which the Milwaukee Street Railway company had no franchise. There were many such streets, he said, and many of them led to very populous parts of the city. Some arrangement could be made, he thought, for the use of portions of the established lines, and as fast as the present franchises expired, the lines operated under them could be bought by the city at a very reasonable figure, or else the company could be compelled to pay a heavy royalty for the renewal of the franchises. City Attorney Hamilton said that if the city desired to do so it could use the streets already in possession of the company, as it had been decided that an exclusive franchise on the roadways of the city could not be granted to any corporation. Aldermen Ramsey and Koehler thought that it would be a good plan for the committee to ascertain how much money could be raised for the purchase or construction of a street railway system, and upon their suggestion the city attorney was instructed to get information on this point and also to report to the committee what legislation would be necessary for the acquisition of the electric railway and lighting plants by the city. It was also decided to confer with Vice-president Payne upon his return from New York and to attempt to get from him figures at which the plants would be sold. However, the aldermen, whether they are in earnest or not, are not apt to go very far in the deal owing to the financial difficulties in the way. The only way in which the city can raise large sums of money is by issuing bonds, and the gap between the amount of city bonds already issued and the limit fixed by law is so narrow that there is no room for bonds for buying the street railway lines. It is still insisted by many that the aldermen are simply making a bluff and that there is no likelihood that the city, even if it can raise the money, will go into the business of running street car lines.

In the United States District Court for the Eastern District of Wisconsin, the Thomson Electric Welding company has scored a decisive victory in its case against the Two Rivers Manufacturing company for infringement of patent. The claim advanced by the defense was that the Thomson patents were null and void because they did not cover any new art, the assertion being made that the art of welding by electricity had been well known before and that there had been numerous prior patents. The attorneys for the defense claimed that only the art of heating by electricity had been previously known, and that in the other processes the welding had not been done by electricity. In the Thomson process the heating and welding are simultaneous and therein was the patentable novelty. At the time that the case was heard, which was several months ago, the Thomson company had a very interesting display of welded goods in court. The exhibit included welded axes, saws with teeth welded in and welded cables. There was one axe, which, when tested, broke elsewhere than in the place where it had been welded. Prof. Thomson attended the hearing. Judge Seaman finally granted an injunction against the Two Rivers Manufacturing company.

The village board of South Milwaukee has finally made terms with W. M. Williams, the owner of the electric light plant in the village, to supply 14 arc lights, for which it will pay Mr. Williams $100 per year each.

The Milwaukee Arc Light company recently had trouble with some of its employes. On August 21st the board of directors decided not to do any more outside construction for some time, and hence it was concluded to dispense with the services of the superintendent, Frederick Raymond. The men held a conference when Mr. Raymond was discharged, and three of them—Alfred Raymond, a dynamo tender and brother of the superintendent; Bernard Ziervogel, a lineman, and Benjamin Peterson, an oiler, decided to quit work unless the superintendent was reinstated. The company refused to comply with this demand and the men stopped work. They claim it was a lockout, not a walkout. The engineer, the fireman and a lineman remained. New men are engaged by the company for the other places, and there was no serious hitch in the operation of the plant. The men, however, laid the matter before the Electrical Workers' Union, and the end is not yet. A committee representing the Federated Trades Council has been conferring with the company in behalf of the men. The company, it is said, has made an offer to reinstate some of the men.

In its suit against the Badger Illuminating company the Milwaukee Arc Light company, in addition to asking an injunction restraining the defendant from interfering with its wires in any way and from molesting it in its business, demands damages in the sum of $25,000.

The Milwaukee Street Railway company has discontinued its transfer stations at the corners of Mason and East Water streets and Reed street and National avenue, and transfer checks are now issued by the conductors. The only transfer station in the city now is the one at the corner of Third and State streets.

General Manager Wyman of the Milwaukee Street Railway company has issued a circular book of rules for conductors. The conductors are urged to keep the front platforms of cars free, especially if there are empty seats in the car; to prevent expectoration on the car floors; and the fact that it takes two to make a quarrel is impressed upon the employes. The little book also contains a time table from point to point along the lines.

The street railway company has adopted its winter schedule. The company is now running 136 cars, and 40 additional cars are put on in the evening and at mid-day. The intervals between cars are as follows: Walnut street and Fond du Lac avenue, six minutes; Greenfield avenue and Third street, six minutes; Wells street, five minutes; Farwell avenue, five minutes; Broadway and Chestnut street, six minutes; Russell avenue, seven minutes; Muskego avenue, nine minutes; Mitchell street, ten minutes; North avenue, ten minutes; Twelfth street and State street lines, eight minutes; Clybourn street horse cars, fifteen minutes; Wauwatosa electric line, twenty-five minutes.

The street railway people rather got the better of the city in the contest over the laying of concrete under the tracks on streets that are being paved with asphalt. When the common council, after the company had offered to compromise by laying concrete under its Grand avenue tracks, refused to repeal the ordinance requiring concrete under all the tracks, the company promptly announced its determination not to lay any concrete even on Grand avenue so long as the city showed any disposition to compel it to do similar work elsewhere. On Grand avenue and Wisconsin street the work of paving was in progress at the time, and the asphalt had to be laid without any concrete under the tracks. Finally the

ordinance to require asphalt under the tracks was placed on file until Vice-president Payne should return from New York. The common council, however, also placed on file an ordinance to give the company the right to lay a spur track on Oneida street to the power house on River street, a distance of about a block. It was intended to use the track for running Vliet street cars from East Water street to West Water street and to use the Oneida and River street spur for running flat cars from the power house to any point on the system, the idea being to haul coal and get rid of ashes by means of the line. There was a squabble between the city and the company over the putting in of curved switches at the intersections of asphalt-paved streets, but the company was finally allowed to put in granite paving at such corners, as the paving with asphalt would have prevented the putting in of switches afterward.

The certiorari proceeding growing out of the assessment of $2,800,000 on the street railway was to have been heard Thursday, but was continued. C.

## PERSONAL.

E. R. Weeks of Kansas City was in Chicago on Monday.

C. L. Borgmeyer of Newark, N. J., representing the Electric Power Storage company, New York, is in the West looking after the interests of that company.

Morgan Brooks, president of the Electrical Engineering company of Minneapolis, was in Chicago on Saturday on his return from an eastern trip. He reports a brighter outlook for business.

John W. Mackay passed through Chicago last week on his return to San Francisco from his visit at New York, where he was present at the completion of the connections of the Commercial Cable company's Atlantic cable from Coney Island, with its offices in the business center of New York.

## NEW INCORPORATIONS.

Middletown Electric Light & Power company, Middletown, O.; capitol stock, $40,000; E. H. McKnight, Middletown, O.

Phoenix Carbon Manufacturing company, St. Louis, Mo.; capital stock, $100,000; to manufacture carbons; Albert Blair, St. Louis.

Upper Cicero Water & Light company, Austin, Ill.; capital stock, $50,000; to conduct electric light and water works; Lawrence Crook, Austin, Ill.

Block Lighting & Power company, New York, N, Y.; capital stock, $50,000; to supply electricity for public and private use; Robert Stafford, New York, N. Y.

Indiana Harrison Telephone Construction company, Lafayette, Ind.; capital stock, $100,000; to construct telephone systems; John R. Coffroth, Lafayette, Ind.

Indianapolis, Anderson, Alexandria & Marion Electric Railway company, Indianapolis, Ind.; capital stock, $100,000; to construct an electric railway; Francis M. Dice, Indianapolis, Ind.

Chateaugay Electric Light & Power company, Chateaugay, Franklin county, N. Y.; capital stock, $6,000; to generate and sell electric light and power; Ernest A. Douglass, Chateaugay, N. Y.

Norwood Electric Light & Power company, Norwood, N. Y.; capital stock, $5,000; to furnish electricity in Norwood and Potsdam, St. Lawrence county; George W. Richards, Norwood, N. Y.

Electro-magnetic Traction company (incorporated in West Virginia), Washington, D. C.; capital stock, $1,000,000; to construct electric motors and equip street railway cars; Philip B. Thompson, Jr., New York, N. Y.

## ELECTRIC LIGHTING.

The city council of Stephenville, Texas, is considering several propositions for the erection of an electric light plant.

A company has been organized to build water works and generate electricity in Grossdale, a suburb of Chicago. Willis Melville, Grossdale, Ill., is a moving spirit in the enterprise.

A press dispatch from Virden, Ill., dated September 14th, says: The electric light plant was completed yesterday, and for the first time the public thoroughfares and some of the buildings were illuminated by electricity last night. The event was celebrated in true country fashion. The people from surrounding towns poured into Virden all day. They were entertained by Ring's band from Girard, and this, with speech-making and games, completed the day's programme. The new plant is the property of the village corporation.

Contracts for the plant for the extension of the municipal electric lighting system of Allegheny, Pa., have been awarded as follows: Westinghouse Electric & Manufacturing company, dynamos, $34,095.33; Babcock & Wilcox company, boilers, $23,342.70; Ball Engine company, engines, $15,000.

Niroqua, Wis., celebrated the introduction of electric lighting on September 5th by speeches, band playing, a ball and other festivities. Besides a general turnout of citizens, hundreds of people from the surrounding country were present to participate in the celebration. Tables to accommodate a thousand at one sitting were spread in the open air and the people enjoyed a general feast. The main business street of the village is lighted by arc lights and all other streets are supplied by incandescents. Every business house in the town is a patron of the new system and a majority of private residences are already wired.

## ELECTRIC RAILWAYS.

The Willow Grove & Hatboro Street Railway company has just been chartered, with John H. Fow as president, to build a trolley line on the Hatboro & Worminster turnpike from Willow Grove to the line between Bucks and Montgomery counties, passing through Hatboro and other Pennsylvania towns.

The North Chicago Street Railroad company has applied to Commissioner of Public Works Jones for a permit to construct a system of poles for electric lines on North avenue from Clark street to Milwaukee avenue, on Belmont avenue from Lincoln avenue to Roby street, thence along Robey street to Roscoe boulevard, and on Roscoe boulevard west to Western avenue.

Evan B. Stotsenburg has been appointed receiver for the Highland Electric Railway company of New Albany, Ind. The company was organized about five years ago with a capital stock of $100,000, one-half of which was subscribed and paid for at 50 cents on the dollar; $50,000 worth of bonds were also issued at the same rate. The company has a floating debt of about $10,000.

An electric railway is to be run from Cincinnati to Hamilton over the Hamilton pike. This will be a continuation of the College Hill electric route, which is now being built by the Cincinnati Street Car company. The right of way, it is said, was secured from the Hamilton Turnpike company by Charles McCrea of College Hill. The work on this route will be commenced within a year.

## TRADE NEWS.

The Washington Electric company, 201–207 South Canal street, Chicago, has excellent facilities for making electrical repairs on short notice.

The educational committee of the National Association of Stationary Engineers has recommended to the members of the organization the system of home instruction offered by the Correspondence School of Mechanics at Scranton, Pa.

A contract for the completed subway work for the West Chicago Street Railroad company has been awarded the National Conduit Manufacturing company of New York. This contract will amount to about $75,000, and the company is naturally elated.

The recent fire in the factory of the La Roche Electric Works, Philadelphia, was confined to the upper floor and roof of the building, doing but little damage. All necessary precautions were taken, and excellent service rendered by the Philadelphia fire department. The plant is now running in full force, and all orders can be promptly filled.

John R. Markle, manager of the western department office of the Electric Storage Battery company, announces the sale to the Merrill Railway & Lighting company of Merrill, Wis., of a storage equipment of 240 kilowatts capacity. This is to be used in conjunction with the street railway generator at present employed, and also to supply a number of street lights which are ran in five series.

The Mather Electric company of Manchester, Conn., reports as a sign of the revival in the electrical business the closing in three consecutive days last week of contracts for more than 1,500 horse power of its standard apparatus, consisting of directly connected and belted generators and its Manchester type slow speed motors. This with the other work which the Mather company now has on hand will compel it to at once increase its working force, although part of its works is now being operated at night.

The Chicago Electric Wire company of Wilmington, Del., has about completed a submarine cable for the United States government. About $50,000 worth of cable has been completed and shipped to Willett's Point, N. Y. The cable, over 700 miles of which has been made, is to be used by the government in the torpedo service. The cable is made in seven strands, the core first being covered with jute, then run through a compound of tar and pitch and then has seven strands of metallic wire, covered with tape twisted around it. It then passes through another tar bath and is then covered with closely twisted Russian hemp.

## BUSINESS.

The valuable electric lighting specialties and other supplies manufactured by the Iona Manufacturing company of 336 Congress street, Boston, are described and illustrated in a catalogue just issued, and which will be sent upon application. This company employs a large corps of skilled pattern and model makers, and has every facility for perfecting and manufacturing small metal novelties, electrical or otherwise.

The Electric Appliance company, Chicago, is having a large sale of its Standard single push flush switch made up in gangs of from two to a dozen on a single large face plate for special work where a handsome finish is expected. As the single pole, three-way and commutation switches are all the same size, they can be mounted very symmetrically, several on a single large face plate, and when the plate is finished specially to match hardware or fixtures a beautiful piece of work is secured.

The Link-Belt Machinery company, Chicago, reports among its recent sales of standard boilers the following: Second avenue Traction company, Pittsburg, Pa., 1,200 horse power; Cosmopolitan Magazine company, New York, 200 horse power; Swift & Co., Chicago, 160 horse power and 325 horse power; Reliance building, Chicago, 200 horse power; Bryan building, Chicago, 100 horse power; Midland Hotel, Kansas City, Mo., 450 horse power; Lehigh Valley Coal company, West Superior, Wis., 400 horse power.

The Mather Electric company of Manchester, Conn., reports through its New York contractors, H. B. Coho & Co., 203 Broadway, the sale of all the electrical machinery for the new Odd Fellows Hall at Philadelphia, consisting of one 30 kilowatt, one 50 kilowatt and one 80 kilowatt directly connected generators and five Manchester type slow speed motors from 1 to 40 horse power, also the sale to the Henry R. Worthington company for its Brooklyn hydraulic works, one 600 light dynamo, one 50 horse power 220 volt generator and one 10 horse power motor.

The E. W. Bliss company, Brooklyn, announces that its European business has been very large, as it has shipped to Switzerland within the last two months a special watchmakers' drop hammer and several punching presses fitted with sub-presses for watch work, also a No. 1½ toggle drawing press; a large shipment to Germany, to one of the largest clockmaking concerns in the world, of tools and machinery for the manufacture of clocks and their cases. France has also received a large shipment of tools for the making of granite enameled ware and kitchen utensils. Austria has not been behind the others, as she has also received Nos. 1½ and 3½ toggle drawing press, Nos. 18, 19, 20 and 21 adjustable power presseses, and Nos. 38½ and 39 power presses with a number of dies, and a No. 161 double action press with dies and special feed for making primers. A large improved automatic perforating press is now nearly completed, and will be shipped to England for the manufacture of perforated metals up to 50 inches in width.

Warren Webster & Co., Camden, N. J., report among the recent contracts for the Webster "vacuum" feed water heater and purifier the following: B. & O. tunnel plant, Baltimore, Md., 3,000 horse power; Westinghouse Electric & Manufacturing company, Brinton, Pa., 2,500 horse power; Pennsylvania Bolt & Nut Works, Lebanon, Pa., two 1,000 horse power; Berwick Electric Light company, Berwick, Pa., 250 horse power; Whitall Tatum & Co., Millville, N. J., 400 horse power; Baker Chain & Wagon Iron Manufacturing company, Allegheny City, Pa., 250 horse power; Samuel Winslow Skate Manufacturing company, Worcester, Mass., 400 horse power; Cincinnati Street Railway company, Cincinnati, O., 1,000 horse power; Arapahoe county commissioners, Denver, Colo., 150 horse power; Erie Chemical company, Erie, Pa., 150 horse power; Pittsburg Tin Plate company, New Kensington, Pa., 400 horse power; city of Boston, Boston, Mass., one special machine; Snow Steam Pump company, Buffalo, N. Y., 100 horse power; Henry Wanklin, Roxborough, Pa., 60 horse power; Fairfield Paper company, Fairfield, Mass., 600 horse power; Chicago Edison company, Chicago, Ill., North Side station, 2,000 horse power; Johnson company, Lorain, O., 3,000 horse power; Philadelphia Gas company, two 600 horse power; Philadelphia Gas company, one 500 horse power. Numerous orders were also received for the Webster separator and the Williams vacuum system of steam heating.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued September 11, 1894.*

525,689. Electric Transformer. Charles S. Bradley, Avon, N. Y. Application filed August 22, 1891.

The magnetic circuit of the transformer is composed of a series of superposed laminæ of iron, each plate being preferably punched with two slots for the coils, as indicated in the cut at *2, 3*. The plates are so assembled that the slots register with each other, thus providing two openings through which the primary and secondary wires may be threaded. The tubular openings are lined with insulating tubes *6*, preferably formed of glass, and allowed to project a short distance beyond the laminated core, so as to thoroughly insulate the conductor from contact with the iron of the transformer. They are held in position against the end walls of the slots by insulating spacing strips *4, 5*. The laminated plates are fixed in position by end plates and tie bolts, as indicated. When the core has been completed a bundle of wires to constitute the primary or secondary coil is bent and its two ends are thrust through one pair of tubes, the wires being of a length which will permit the projecting ends to be bent into contact. The projecting ends are then united, preferably by electric welding, so that the entire bundle of wires will form a complete coil.

525,690. Electric Railway System. Charles S. Bradley, Avon, N. Y. Application filed January 2, 1894.

The motors may be started and gradually accelerated in speed without the necessity of resistance or starting switches as ordinarily employed. The system is provided with a plurality of alternating current supply generators of different frequency, connected with distributing lines, and motors adapted to be supplied by the several lines. More specifically it comprises an electric railway system so organized as to permit a train to be controlled by a polyphase alternating current of high or low frequency at the will of the motorman.

525,697. Winding for Drum Armatures in Dynamo Machines. Rudolf Eickemeyer, Yonkers, N. Y. Application filed March 9, 1892.

The armature drum is covered with a wire winding in divisions, each of which is made up of a group of two or more in-

dividnal members or coils, each having a long side and a short side lying along the periphery of the drum in two or more layers, and inclined ends lying across the heads of the drum in flattened webs of a single thickness of wire, the long and short sides of the individual coils in each division or group being separated on the periphery of the drum by spaces which receive respectively the short and long sides of other similar individual coils belonging to other similar groups, and the long sides in each group being arranged on the periphery of the drum in the reverse order of the short sides of the same group.

525,698 Armature for Dynamo-electric Machines. Rudolf Eickemeyer, Yonkers, N. Y. Application filed April 3, 1894.

It is proposed to produce electrically and mechanically balanced armatures; to secure the several coils or sections of winding against displacement on the armature core, under the strains incident to service; to provide an abundance of air spaces among the ends of the coils or sections, at the ends of the armature, for ventilating and cooling the winding, and to enable the construction of the coils or sections, as well as their assemblage on cores, to be done economically and by comparatively unskilled labor.

525,702. Telephone Call System. Ezra T. Gilliland, Pelham Manor, N. Y. Application filed November 27, 1893.

In this arrangement a magneto telephone instrument is employed which may act either as a transmitter or receiver. Connections are made by which this instrument is ordinarily in the line circuit, and there are means for imposing upon the line circuit intermittent or pulsatory currents, which, passing through the receiver, will actuate its diaghragm and produce a call signal.

525,703. Telephone Call System. Ezra T. Gilliland, Pelham Manor, N. Y. Application filed January 11, 1894.

The switch is maintained in a position to cut out the telephone coil and cut in the call apparatus by mounting the switch so that gravity will act upon it in a line passing parallel or approximately parallel to the handle, placing the mouthpiece preferably in the plane of the handle, so that in using the mouthpiece it will necessarily be on a higher plane or level than the handle, and provide the instrument with a supporting device so related to it that the mouthpiece will normally occupy a lower level than the handle.

525,704. Electric Clock. Fred L. Gregory, Chicago, Ill. Application filed January 30, 1894.

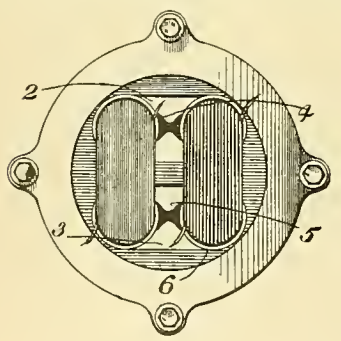
There is here provided a circuit-making apparatus in which the circuit shall be closed or completed by a rubbing contact under pressure, so as to maintain the contact points or surfaces bright and in proper working condition, and at the same time provide effective means whereby the circuit-closer will, during the contact period, be actuated to carry it under and past the electrical terminal or terminals with great force, and independently of the power (for the movement) of the time-train to which it is connected.

525,708. Bus Bar Insulating Support. Albert B. Herrick, Schenectady, N. Y. Application filed April 11, 1894.

This support consists in a rack or frame of cast-iron or other material of sufficient strength, in which are arranged insulating blocks made of porcelain or other non-combustible insulating material. These occupy guideways in the frame, so that they may be replaced with ease and permit the removal of any one conductor or set of conductors without disturbing the remaining conductors in any way. The insulating blocks are made in two parts, so shaped that they furnish openings to receive the conductor, and fastened to the frame so that they may be removed independently.

525,730. Electric Fan. Charles Wachtel, Newark, N. J. Application filed January 17, 1893.

This is a suspended electric fan provided with a tubular support forming a conduit for the wires for conducting the current, a bridge-piece core provided with pole-pieces attached to the support, a main supporting frame secured to the bridge-piece core, provided with a bearing, a fan shaft adapted to rotate in the bearing, means on the shaft for rotatively securing the shaft in the bearing, a supporting plate or armature carrier on the shaft, consisting essentially of a plate provided with a




NO. 525,689.

sleeve and a screw for securing the same to the fan shaft, lugs on the under side of the plate provided with screw holes, and an armature having screws or bolts passing through the armature sections thereof and screwed into the holes in the lugs for securing the same to the carrier or supporting plate.

525,735. Electric Arc Lamp. Stewart L. Campbell, Kalamazoo, Mich. Application filed January 23, 1894.

This lamp was designed especially with the view of providing a mechanism that can be easily put together and taken apart, and in which parts can be removed for repairs without disturbing the adjustment of the remaining parts.

525,743. Electric Arc Lamp. Alexander B. Roney, Chicago, Ill. Application filed March 7, 1894.

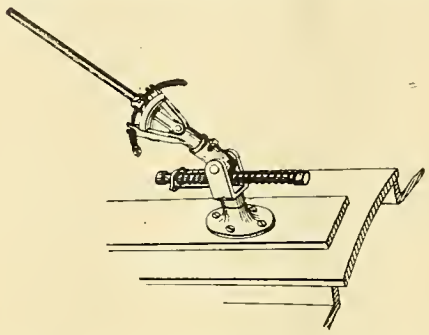
Each of the carbon electrodes is made in two pieces, the pieces of each pair constituting a single electrode and being fed into contact with each other to supply the waste of carbon due to the burning. The arc is formed between the two electrodes opposite the juncture formed between the two pieces of each, so that the wasting occurs in each electrode at the meeting point of its two separate pieces of carbon. This arrangement dispenses with the necessity for a clutch carbon feeder, such as are so commonly used, and it is claimed produces a strong and brilliant light of a peculiar character, makes the lamp compact and obviates in great measure the shadows in a downward direction.

525,769. System of Electrical Distribution. James F. McElroy, Lansing, Mich. Application filed October 5, 1887.

The first claim follows:
The method of transformation and utilization of electrical energy, consisting in charging one member of a condenser with electricity of a certain tension and volume and simultaneously therewith, and thereby charging the other member of the said condenser with electricity of different tension and volume, and then discharging the latter and passing the transformed electricity to one or more translating devices.

525,779. Synchrooizing Mechanism for Electric Motors. Edgar Ayres, Sydney, Australia. Application filed October 7, 1893.

There are two parts to this invention, the first consisting of appliances for alternately completing and breaking an electric circuit that controls the second part, namely, the apparatus for moving other clocks synchronously.



NO. 525,789.

525,782. Combined Brake and Electric Switch for Street Railway Cars. George Brown, Long Island City, N. Y. Application filed January 20, 1894.

The principal features of the improvement are a combined automatic brake and electric switch for street and other railway cars, comprising the car brakes and several switches adapted to gradually increase or decrease the current, and means for applying or releasing the brakes and actuating the switches successively at the same movement.

525,789. Trolley Pole Connection. Maurice R. Mahon and John Melick Crane, Newark, N. J. Application filed November 10, 1893.

The trolley wheel or pulley is prevented from being thrown off the conducting wire by the lateral motion or swaying of the car from side to side while in motion, and also from wearing away the sides of the wire by making the pivotal joint in a direct line and at right angles with the axis of the pole, and so that these relations will be always maintained irrespective of the angle of elevation of said pole. This feature is illustrated in the accompanying cut.

525,836. Self-adjusting Brush for Dynamo-electric Machines. W. L. Bliss, Brooklyn, N. Y. Application filed April 13, 1894.

This is a simple method of automatically shifting the brushes by the act of reversing the rotation of the armature and for the arrest of the so shifted brushes in such positions that their polarity will be made to correspond with the reversal of the rotation of the commutator, or, in other words, will remain constant.

525,840. Lightning Arrester. Archibald L. Courtright, Keokuk, Ia. Application filed February 1, 1894.

The invention relates to a method for automatically controlling an electric circuit, and consists of a valve which is capable of adjustment, so that it may be set to operate by variations in the current from a given electromotive force. The valve may be employed as a protector of mechanical apparatus; for example, in a circuit having a number of motors or dynamos.

525,864. Electric Railway. Herbert E. Rider, New York, N. Y. Application filed February 26, 1894.

In this underground conduit, illustrated in the accompanying cut, the frame resembles in construction those now employed for cable railways, and is provided with heavy cross-pieces, which support the track and the slot-forming plates, which may be of any suitable construction. These cross-pieces are provided with a central opening under the slot and shelf-like supports, which are preferably cast in one piece with the cross-pieces. These shelves are located some distance from the bottom of the conduit and at the side of the conduit, so as not to be near the vertical line beneath the slot. Upon these shelves the main conductor or conductors are supported.

525,866. Electrical Signaling Apparatus for Railways. Paul Schwenke, Zerbst, Germany. Application filed April 8, 1892.

The principal claim is given:
In an electric railway signal the combination with two line circuits, each including a generator, a circuit breaker and a relay, of a signaling circuit including the armature and contact point of one of said relays, a generator and an electro-magnet, an armature for said magnet, means for retracting said armature, a signaling device, means for communicating the movement of said armature to said signaling device, a shunt circuit from said signaling circuit, said shunt circuit including the armature and contact point of the other relay, and an electro-magnet, an armature for said magnet, and means for retracting said armature, the free end of said armature when in its retracted position engaging the rear side of the armature of the electro-magnet in the signaling circuit.

525,874. Electric Annunciator. Henry C. Thomson, Boston, Mass. Application filed July 2, 1894.

The characteristic feature of this improvement consists in the construction and arrangement of the index magnets, and their combination with the index fingers, and also in the construction of the restoring or lifting device.

525,886. Trolley for Electric Railroads. Edward Dawson, Terre Haute, Ind. Application filed December 26, 1893.

Claim 2 follows:
The combination, with a socket adapted to be secured to a trolley pole, of two brackets secured to the said socket and provided with screw-threaded bosses at their upper ends, and a hollow pin screwed upon the said bosses and forming the bearing for the trolley wheel.

525,888. Manufacture of Carbons for Electric Lamps. Thomas A. Edison, Menlo Park, N. J. Application filed March 20, 1880.

The invention consists in the discovery that an incandescing conductor of very high resistance in comparison to the radiating surface may be made of such natural fibers as are capable of carbonization, especially those which are large, filamentary and cellular in character, such as jute, hast, manila, hemp, etc. These fibers are of endogenous growth, and are made up of parallel filamentary fibers running lengthwise of the main fiber and not interlacing or radiating from the center to the exterior. They are by the nature of their growth compact and filamentary bundles of elementary fibers, the bundles being separated from each other or surrounded by pith, which can be readily removed, leaving a fiber approximately of the size required for the filament of an incandescent electric lamp. Hence these natural fibers only require a slight external shaping in order to make them suitable for carbonization for forming carbon filaments, no splitting of the fiber being required and the natural structure being left undisturbed.

525,894. Recording Voltmeter. Frederick D'A. Goold, Schenectady, N. Y. Application filed April 16, 1892.

One of the claims is given:
In a recorder, the combination with a movable recording surface of a recorder, a series of levers comprising a parallel motion, to which said recorder is secured at the point which moves in a straight line, an operating coil, an armature moved thereby, said armature being suspended from said levers at the point where the recorder is secured, and an adjustable spring also connected to said levers at the point where the recorder is secured.

525,909. Incandescent Lamp Stand and Reflector. George F. Klemm, Philadelphia, Pa. Application filed June 9, 1894.

This is a portable and adjustable appliance for application to an article of furniture provided with an electric lamp mounted in a slotted reflecting tube or cylinder and arranged so that the illumination derived from the lamp is concentrated in any required direction.

525,936. Electric Switch. George Baehr, Jersey City, N. J. Application filed January 9, 1894.

The principal features of this invention are improvements in the construction and form of knife switches.

525,891. Fastener for Electric Wires. Harry C. Fricke, Pittsburg, Pa. Application filed June 14, 1894.

This device comprises a metal spike provided with an open head adapted to be clamped about the wire, or about a piece of insulation surrounding the same, together with the peculiar construction of the insulating piece.

525,943. Electric Arc Lamp. Harold E. Bradley, New Bedford, Mass. Application filed February 28, 1894.

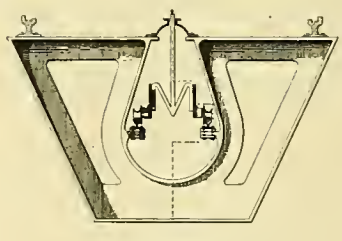
The advantages gained in this construction include regular feed mechanism and a resistance and cut-out which will work automatically to short-circuit the lamp if the current becomes too strong, and so prevent the burning out of the lamp.

525,945. Conduit System for Electric Railways. W. G. Creighton, Chicago, Ill. Application filed February 28, 1894.

The rail is utilized to form part of the conduit, the remainder being formed by a plate or bar placed alongside of and running parallel with the rail and having a grooved or channel-like portion that overhangs one edge of the tread of the rail, so as to provide a lateral and vertical opening or slot that leads into the conduit. Through the slot passes the plow or traveling contact that on two opposite sides has projections, whose upper faces are beveled or inclined downward to enable them to readily engage and raise into the groove of the plate the flexible slot closer that otherwise rests upon the edge of the rail.

525,992. System of Lighting and Heating Cars by Electricity. Morris Moskowitz, Newark, N. J. Application filed March 31, 1894.

A dynamo, driven from the car axle, and two sets of storage batteries, one of which may be charged while the other is being discharged, are the main features of this invention.



NO. 525,864.

525,993. Means for Equalizing Electromotive Force of Dynamos. Morris Moskowitz, Newark, N. J. Application filed June 15, 1894.

The principal claim is given:
In a means for the purpose of equalizing the electromotive force of dynamos or other electrical apparatus running under variable speed, the combination of a dynamo-electric generator and a combined motor and regulating dynamo, comprising therein a combined armature shaft a motor armature and brushes, and a dynamo armature and brushes on said shaft, the armature circuit of said regulating dynamo being in circuit with the magnetic fields of said dynamo-electric generator, so that the electromotive force of said regulating dynamo excites and controls the intensity of the magnetic fields of said dynamo-electric generator, and means connected with the combined dynamo and motor shaft for operating the same, and an opposing circuit connecting the field coils of said regulating dynamo with the main circuit connecting with said dynamo-electric generator, counteracting the electromotive force of said regulating dynamo to maintain the electromotive force of the dynamo-electric generator constant.

526,016. Electric Motor. John S. Losch, Summit Station, Pa. Application filed March 6, 1894.

The arrangement of the commutator with relation to a series of brushes bearing thereon forms the chief feature of the invention. These are connected to the field coils, by means of which the active or effective point of the magnet field is caused to rotate in the same direction as the armature, and at a rate of speed greatly in excess of the same, by which a series of impulses is exerted upon the armature greatly in excess of the number of field coils, and the speed of rotation and efficiency of the machine as regards power are greatly increased.

# Western Electrician.

EVERY SATURDAY.

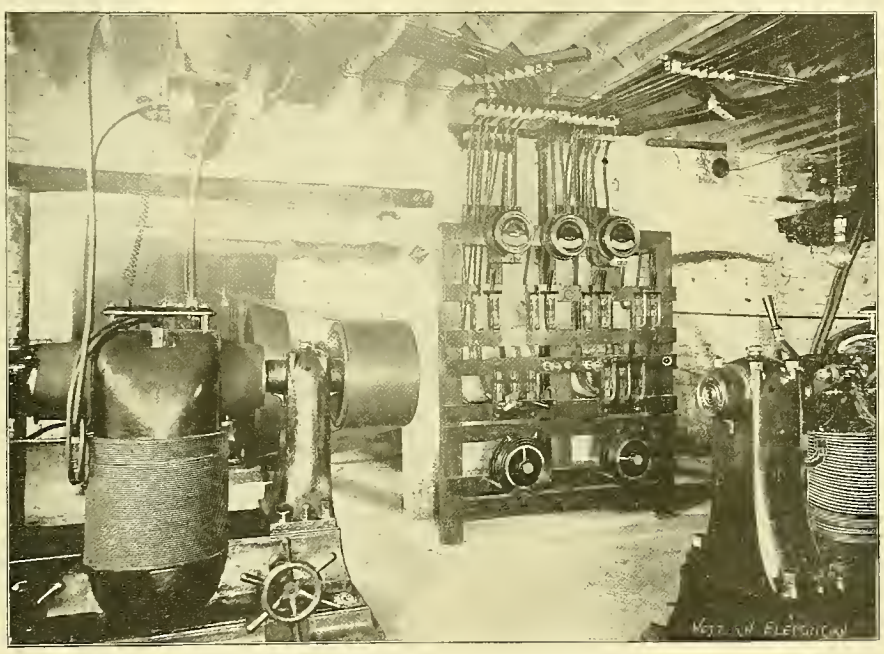
Vol. XV. CHICAGO, SEPTEMBER 29, 1894. No. 13


## Lighting Plant of the Leland Hotel, Chicago.

The recently installed lighting plant in the Leland Hotel at Michigan avenue and Jackson street, Chicago, has for its most notable feature the very thorough manner in which the wiring of the building, erected some years ago, has been carried out. This hotel is believed to be the first old building in Chicago to be wired in exact accordance with the new requirements of the city bureau of electrical inspection. Its interior construction is largely of wood, and the lighting conductors are carried on porcelain knobs or through porcelain bushings throughout. Of the latter there are over 6,000 in the building. The hotel is connected for 1,650 incandescent lamps, and the job of wiring will impress electricians as an excellent one.

The generating plant, depicted in the accompanying illustration, is located in the basement of the building and consists of two 80 horse power M. A. Green engines directly belted to two 50 kilowatt 125 volt dynamos of the new type of the National Electric company. The engines are operated at 300 revolutions per minute, the cylinder dimensions being 12 by 12 inches. The dynamos are easily capable of generating current for 800 lights each. They are bipolar machines, strong and well built, with symmetrical outlines. The field magnets are powerful and massive, while the armatures are comparatively small. The latter are of the standard drum type and the core is built up of steel disks. The speed is about 900 revolutions per minute. The two machines are not run together but in relay. The heaviest load at this time of the year is about 8 P. M., when from 750 to 800 lights are carried.

The switchboard is of the skeleton wooden construction, as shown in the illustration. The switches have slate bases, and the bus bars are arranged so that there is no actual contact with the board. Wirt measuring instruments and Carpenter enamel rheostats complete the equipment. The plant is purely a lighting one, and no motors are connected with the wiring system. The whole installation was carried out by the Louis K. Comstock company.



LIGHTING PLANT OF THE LELAND HOTEL, CHICAGO.

## American Institute of Electrical Engineers.

At the last meeting of the council of the American Institute of Electrical Engineers, New York, the following named applicants for admission were made associate members:

Geo. O. Baker, New York; Ernst Julius Berg, Schenectady, N. Y.; Charles M. Blanchard, Germantown, Pa.; Willard E. Boileau, Columbus, Ga.; E. D. H. Brady, Waterbury, Conn.; Edward D. Brown, Harvey Stuart Chase, New York; George Boune Compagnie, Antwerp, Belgium; J. W. Crews, Norfolk, Va.; Harry Cooke Cushing, Jr., Boston, Mass.; Frederic W. Darlington, Philadelphia, Pa.; Darragh DeLancey, Rochester, N. Y.; William A. Drysdoll, Philadelphia, Pa.; Francis Maron Dyer, New York; Morton Edward Eden, Philadelphia, Pa.; Wm. C. L. Eglin, Philadelphia, Pa.; Chas. L. Eidlitz, New York; Edward B. Ellicott, Chicago, Ill.; F. Wm. Erickson, Pittsburg, Pa.; Frank G. Fuller, Meriden, Conn.; Louis Jay Gerson, Philadelphia, Pa.; Elwood Aristides Grissinger, Mechanicsburg, Pa.; Herman Hollerith, Washington, D. C.; G. Wilbur Hubley, Louisville, Ky.; Arthur L. Hunt, Utica, N. Y.; Carl E. Kammeyer, Chicago, Ill.; Fred A. La Roche, Philadelphia, Pa.; Chester Wolcott Lyman, Herkimer, N. Y.; James Lyman, Ithaca, N. Y.; Frank P. Medina, San Francisco, Cal.; L. E. Myers, Chicago, Ill.; Henry Noel Potter, Pittsburg, Pa.; Chas. W. Price, New York; Harry D. Reed, New York; Robert E. Richardson, Chicago, Ill.; Wm. H. Roberts, Cincinnati, O.; John E. Roller, New York; Arthur John Rowland, Philadelphia, Pa.; W. J. Shields, Burlington, Vt.; Arthur J. Slade, New York; Frank E. Smith, San Francisco, Cal.; J. Franklin Stevens, Philadelphia, Pa.; Frank M. Tait, Catasauqua, Pa.; Thomas W. Varley, Passaic, N. J.

Announcement is made by the secretary of the appointment of B. J. Arnold as local honorary secretary for the Chicago branch, to fill the vacancy made by the resignation of Edward Caldwell.

## New York State Street Railway Association.

The twelfth annual meeting of the Street Railway Association of the State of New York, was held at the Yates, Syracuse, N. Y., Tuesday, September 18th. President D. B. Hasbrouck presided. The following named delegates of railroad companies were present:

John W. McNamara, Albany Railway company; A. H. Underwood, Auburn City Railway company; J. Tracy Rogers and J. P. E. Clark, Binghamton Street Railroad company; W. J. Richardson, Atlantic Avenue Railroad company, Brooklyn; J. B. Craven, Buffalo Railway company; C. A. Derr, Rochester Electric Railway company, Charlotte; W. W. Cole, West Side Street Railroad company, Elmira; P. J. Gleason, L. I. City and Newtown Railroad company; D. B. Hasbrouck, Metropolitan Railroad company, New York; J. H. Stedman, Rochester Railway company; John S. Wardwell, Rome City Street Railway company; W. R. Kimball, John H. Moffitt, W. P. Gannon and Paul T. Brady, Syracuse Street Railway company.

There were also present:

A. J. Belden, New York; Henry W. Blake, New York; Paul T. Brady, Syracuse; Frank X. Cicott, Boston; Stephen L. Coles, New York; T. E. Crossman, Brooklyn; H. C. Evans, New York; Allen R. Foote, Washington, D. C.; William F. Forby, New York; H. H. Foster, New York; Charles M. Fuller, Portland, Me.; John A. Granger, New York; W. E. Harrington, Philadelphia; Thomas Hooker, Syracuse; Henry G. Issertel, New York; E. J. Lawless, St. Louis; W. B. Le Van, Jr., Brooklyn; Frank A. Magee, New York; R. J. Mercur, Buffalo; Edgar Peckham, Kingston; H. C. Porter, Syracuse; F. D. Russell, Rochester; John A. Seely, New York; John Taylor, Troy; Edward P. Sharp, Boston; C. E. Stump, New York; A. C. Vosburgh Syracuse; F. W. Wilcy, Boston; Edward B. Wyman, New York; Jefferson Young, Syracuse.

In opening the convention President Hasbrouck made an address in which he said:

The street railway companies of the state should act in concert in all matters in which they have a common interest; and there is no way in which they can better protect themselves than by acting together as members of this association. The motto adopted by the Dutch founders of our city of Brooklyn, "Een Draght Mackt Maght," which may be freely translated, "One pull makes a strong pull," ought to teach us a profitable lesson. Measures have been taken which, it is hoped, will induce every company within the bounds of the state to unite with us for the common good.

Following is an abstract of the report of the executive committee:

The membership now consists of thirty companies, the highest number yet reached; the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway company has withdrawn, but the Syracuse Street Railroad company, our host on this occasion, and the Horneilsville Electric Railway company have more than taken the place of the first named company, its officers having always manifested but slight interest in the welfare of the association. This fact leads us to remark that the officers or members who have been most interested in the success of the association have been those most intimately connected with its work, especially in legislative matters, which, indeed, is the essential reason of its existence.

The subject selected by the author of the report on "Economy in Electric Power Stations" is one in which a large number of member companies using electric power are deeply interested. Economy is a word that is ever ringing in our ears, and he who produces the largest financial results at the least possible cost is the man for whom the sharp eye of the world is ever on the lookout. Electric power has boomed into almost universal use in so short a time that it is not at all strange that in a number of departments of the service there are places where greater or less waste is to be discovered and remedied by the economical mind. One of these departments will be carefully treated at this meeting from the standpoint of economy.

One of the main features of the work accomplished by the association is that of giving careful attention to the street railway interests during and following the annual sessions of the Legislature. In order that the best possible care be taken thereof, the association has secured the services for the last three years of special counsel in the person of Charles J. Bissell, of Rochester, N. Y. We hereby express our appreciation of his faithful, devoted attention to the interests of our business before the Legislature and the governor. His work is faithfully and conscientiously performed, and by the exercise of rare tact he has been able to protect our business from the enforcement of unreasonable demands that have from time to time been attempted to be made through the medium of the Legislature. This successful result has been in large measure accomplished through the assistance rendered counsel by the extensive membership of the association, the officer of a relatively small company often having greater personal influence with his representative than the man in the great city. "In union is strength," and the truth of the adage has found very satisfactory demonstration in the history of our society. For this special reason, therefore, is your committee desirous of having every street railway company in the state, no matter how small the company may be, a member of the association.

The report closed with a feeling reference to the death of three prominent members: William Richardson, Henry W. Slocum and Edward F. Drayton.

The report of the treasurer was presented and showed the financial transactions of the year to be: Receipts, $5,860.09; expenses, $5,381.20; balance, $478.89.

J. B. Craven presented a paper on "Economy in Electric Power Stations," which will be found in another column.

The paper of George W. McNulty on "Recent Improvements in Cable Traction" was then read.

The papers of Messrs. Craven and McNulty were ordered to be received and printed in the minutes. A voluntary paper by Allen R. Foote of Washington, D. C., on "Taxation," was next presented.

The nomination of officers and selection of next place of meeting being the next business in order, Messrs. McNamara, Rogers and Gannon were appointed the nominating com-

mittee. The committee made the following report: President, G. Tracy Rogers, Binghamton; first vice-president, John H. Moffit, Syracuse; second vice-president, William W. Cole, Elmira; secretary and treasurer, William J. Richardson, Brooklyn; executive committee, D. B. Hasbrouck, New York; John N. Beckley, Rochester; Daniel F. Lewis, Brooklyn. Place of next meeting, Albany. The report of the committee was approved.

Exhibits were displayed by the following concerns: H. W. Johns company, Consolidated Car Heating company, Taylor Electric Truck company, Cutter Electrical Manufacturing company, Davis Automatic Car Shade company, Peckham Motor Truck & Wheel company.

In the afternoon the visitors were driven around the city and shown the various points of interest. An inspection was made of the new track being laid by the Syracuse Street Railway company. In the evening a complimentary banquet was tendered to all in attendance and was a pleasant affair.

## The Electric Brake in Practice.[1]

By Elmer A. Sperry.

Enterprise in the United States for the public convenience of her citizens is truly phenomenal and reaches its highest expression in conveniences for travel. The per capita investment in the cities and larger towns of this country for electric street railroad work is much larger than is often realized; in some no less than $55 is invested for each man, woman and child for accommodation in intramural travel. The enormous aggregate sum thus invested has given a stimulus to engineers, resulting in wonderful advancement and refinement in means for mobilizing the thousands of

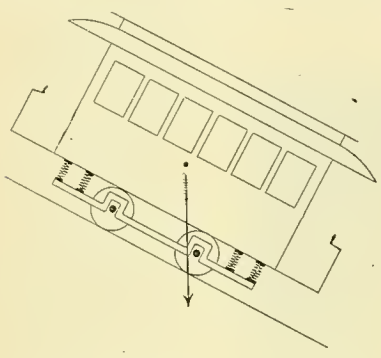


FIG. 1. THE ELECTRIC BRAKE IN PRACTICE.

tons of human freight that are hourly seeking transport. Vast skill and almost untold resources have been devoted to perfecting means for overcoming inertia and quickly accelerating cars and trains, which are ever increasing as to their weight and capacity, with patrons constantly more exacting as to speed and smoothness of operation, and especially as to safety. It is proverbial that while these advancements have been going forward, comparatively no attention has been paid to the mechanism for retarding and quickly but smoothly bringing the cars and trains to a stop.

The popular appreciation of this point is illustrated by the growing frequency of its discussion by the daily press in our larger cities. The following is an extract from an editorial recently appearing:

> The number of deaths due to motor cars has alarmingly increased since the trolley system liberated the slow-going horse and mule. Not that the deaths are due to the electric current. The "deadly trolley" notion has properly been exploded. It is the car wheels that are doing the deadly work. Now that the motors and trucks have been in a measure standardized, managers of large roads, especially, are being asked by their patrons why they do not adopt proper precautions so that the death rate may be cut down. There is no one part of electric or cable railroading so important as the ability to stop the cars quickly. At such times hand-brakes show their inherent inadequacy.

As the practice of the steam railroad engineer as to roadbeds, speeds and weights are gradually approached, his experience in the solution of this most important problem of braking should be studied with care. In so doing, however, the features wherein the street car problem is differentiated from the steam road problem should be kept prominently in mind. We must remember that the locomotive engineer is provided with a complete, expensive and somewhat intricate apparatus with which to de-energize his train. The periods of its application are comparatively infrequent, and as to personal capabilities, he is schooled and trained for years before ever being allowed to touch either the throttle or the air valve. While working his pressure guages allow him to adjust the brake application to a nicety. Moreover, the time allowed for the total retardation and final stopping of his train is usually very long as compared with that allowed in street railway practice.

Of the two, the street railway problem is the more exacting, and in the hands of far less experienced operators; and yet we are told that the mechanism involved in its solution must bear only a small ratio to the cost of the total equipment. Owing to the recently developed relation between effective braking and the accident and damage account, the purchaser will be spurred on to careful investigation as to the brake applied to his cars and will be willing to spend sufficient time and money to effectually control retardation, as well as acceleration of the car. To be sure, as little expense should be incurred here as possible, but enough to fully meet the requirements. Especially is this true, now that ample power for applying the heaviest brakes is at hand, and even if used in a wasteful and extravagant manner in the largest amount possible, is entirely without cost, and its means of control already at hand. The importance of this proposition should at once command the attention of all, and commend the problem as such to the engineer.

Examination of accounts of the electric street railway companies of our large cities reveals the fact that the item of damage, already very great, is one of growing importance. Investigation of the circumstances and detailed statements of numerous items taken at random from the damage account point at once and in no uncertain way to the inefficiency of the present hand brake. In many instances, could the car or train have been stopped within a comparatively short distance, the accident and resultant damages would have been entirely averted. The first investigation led to others with the same result, and in consequence the writer is prepared to show that nearly 85 per cent. of the accidents directly occurring are due to the inefficient operation of brakes. The growing frequency of accidents and the constantly increasing demands of the public for damages are indications that have not been made to impress the mind of the engineer, or I am sure adequate means would have been forthcoming for the correction of so grave a fault inherent in all the present systems of power-operated street cars. Some of our municipal authorities are taking action with reference to the increasing frequency and severity of accidents, and although no thorough scientific investigation of the matter has been published, yet it is a startling fact that with the present hand brake, no electric or other equipment to-day stands provided with anything in the line of an emergency brake. In so grave and urgent a case, what can be done in the line of remedy? The questions naturally arise: Will any system of braking worked upon or in connection with the ordinary wheel of a vehicle be sufficient for the stop required? What is the maximum efficiency obtainable by the brake working through the wheels? Is it sufficient to arrest the car before accident in case of emergency? Can it be made in any event a sufficient accident preventer? The popular notion that most accidents are due to brake failure is true, but in a way that is little understood, the failure being one of degree. It may not be known that under proper and standard conditions any car or train may be brought from a speed of 10 miles an hour to absolute rest inside of 10 feet. It is not generally appreciated that the wheel brake has ample capacity to accomplish this. The former investigations of the writer with reference to adhesion under conditions of acceleration and retardation, climbing and descending hills, afford ample proof that the rail adhesion through the wheels gives the wheel brake more than capacity sufficient to accomplish this result. For instance, assuming any weight and load, say 17,000 pounds, the stored up energy, 64,426 foot pounds can with ease be dissipated within 20 feet for the ordinary equipment, and less than half of this distance, or a little over nine feet, under conditions of coupled drivers, or if the wheels are compelled to revolve in unison. This latter consideration will be seen to have quite an unexpected as well as pertinent relation to the problem. It will be seen by a glance at the figures that the center of gravity of the mass is far above the wheel contact with the rail. The retarding effect takes place on the base line in a plane below that of the center of

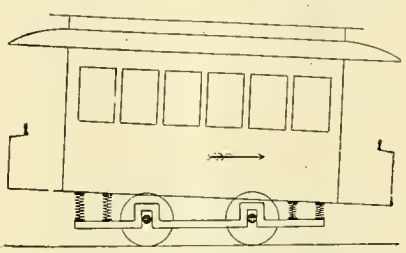


FIG. 2. THE ELECTRIC BRAKE IN PRACTICE.

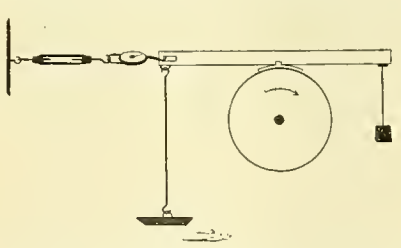


FIG. 3. THE ELECTRIC BRAKE IN PRACTICE.

gravity, really the farthest projection downward of the mass as a whole. A sudden stop operating on this base line tends to pitch the upper portion forward, bringing nearly all of the weight, and with it the retarding capacity, upon the front pair of wheels. The brakes on the rear pair in the ordinary equipment will have but little effect; if, however, by any practicable method they are coupled to the forward drivers, the brakes on this rear pair still remain active and of full effect. This is true even if the back pair should be lifted clear of the track. With increased weight upon the forward drivers comes ample increased adhesion; thus preserving the full tractive effort of the total weight intact for purposes of stop, which is impossible in the ordinary equipment. These effects are all aggravated in case of short wheel base. The present tendency toward a longer wheel base is a step decidedly in the right direction and should be encouraged. The effect of shifting the load in reference to the axles will be especially noticed in descending hills, as shown in Fig. 1, where the momentum of the rapidly retarded mass tends to shift the load centers still farther forward, in some cases almost wholly onto the front drivers. It will be seen to have a greater effect than in ascending grades, where, in stopping, the inertia tends to correct the position of the shifted load, whereas going down, in stopping, the momentum as stated tends to still further aggravate the condition. The practical effect of this may be seen whenever an ordinary street car mounted upon springs of fair resilience is quickly stopped. The car will be seen to suddenly right itself, having been pitched forward in the process of stopping, as shown in Fig 2, the front springs being depressed and the rear springs extended. These considerations all go to show in a new light the advantages to be derived from coupled drivers for general street railway service.

Bearing these facts in mind, let us turn for an instant to the ordinary hand brake. The ratio in the brake levers will be found in the modern trucks to be anywhere from 6 to 11½, averaging about 8½ to 1. The lever arm of the brake staff will be found to be anywhere from 6 inches to 13 inches. Assuming 11 inches as the average, the radius from the center of the brake chain to the center of the brake staff will be 1¾ inches, giving thus 6.28 to 1, or a total leverage of 53.4 to 1 from the operating handle to the brake beam. Two elements now have to be assumed. First, the friction coefficient of the brake shoes acting upon chilled wheels; second, the power upon the brake staff. The writer has endeavored to cover both of these unknown quantities by actual experiment, giving the results in the tables. Table I. was taken by a dynamometer being fastened directly to the brake staff handle in line of the pull of the motorman, a cast-iron brake wheel 16 inches diameter from center to center of a 1¼ inch rim bearing the handle. A number of experienced motormen were invited to test their strength upon this handle and careful readings were taken. It was noticed that the arm of the more experienced motormen was much more developed than the left, a fact which I think has been pointed out before. The extent of this development in the forearm is certainly quite marked, showing that the gripping

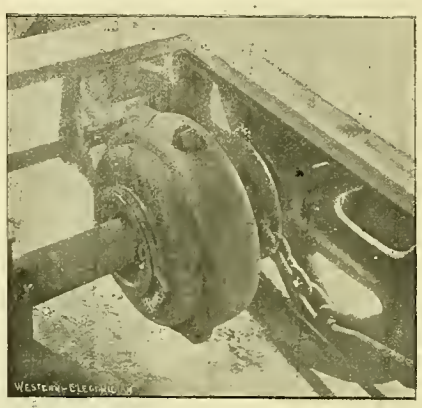


FIG. 4. THE ELECTRIC BRAKE IN PRACTICE.

muscles and weight of the body are the elements brought most into play.

TABLE I.

| No. of motorman. | Weight of motorman | Gradual pull with one hand. | Jerk with both hands on hand wheel. | Emergency jerk with both hands on han wheel. |
|---|---|---|---|---|
| 6 | 140 | 112 | 135 | 275 |
| 58 | 200 | 135 | 275 | 385 |
| 264 | 287 | 145 | 235 | 312 |
| 62 | 175 | 125 | 212 | 285 |
| 123 | 153 | 125 | 245 | 310 |
| 60 | 185 | 150 | 200 | 300 |
| 26 | 170 | 130 | 275 | 350 |
| 96 | 155 | 135 | 210 | 325 |
| 246 | 135 | 110 | 175 | 325 |
| 287 | 155 | 125 | 250 | 350 |
| 66 | 160 | 125 | 250 | 405 |
| 4* | 176 | 100 | 200 | 400 |
| 266 | 185 | 175 | 250 | 375 |
| | | Av. 131.7 | 224 | 338.23 |

*9 years in service.
Right arm, circumference of forearm, 12¾ in.
Right arm, circumference of biceps, 14¼ in.
Left arm, circumference of forearm, 11⅝ in.
Left arm, circumference of biceps, 13⅝ in.

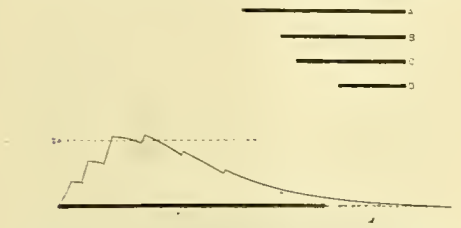
Columns 1 and 2 indicate respectively the number of the motorman and his weight. Column 3 indicates the greatest possible steady pull with the right hand on the handle, bringing into play all possible weight of the body. Column 4 indicates the same conditions as column 3, the motorman in this case grasping the hand-wheel with both hands, some motormen using gloves to prevent their hands slipping. None of the men could maintain these values for more than half a second. In column 5 is indicated an "emergency stop." The motormen were told to "break the machine" if possible. In this test the body was braced, sometimes with the knee against the dasher rail, the needle registering the highest jerk usually given with a sudden lunge of the body.

It will be seen that the power applied by the steady pull of the average motorman is about 131.7, and can be made to run up in case both hands and the weight of the body are used, to about 224 average, but this value cannot be maintained, The average values of column 5 cannot be used in these calculations, for the reason that although they show the pressure it is possible to reach by jerking upon the hand-wheel these pressures cannot be maintained and therefore cannot be depended upon for braking effect. The tests show that the full power that can be maintained upon the brake leve

1. Read before the American Institute of Electrical Engineers, September 19, 1894.

for a sufficient length of time for the purposes in hand does not exceed an average of 180 pounds.

Table II. was obtained as shown in Fig. 3. A brake shoe that had been run in service about three or four days was taken with the axle carrying its coöperating wheel, lifted out of the truck and placed between the centers of a lathe, the load upon the brake shoe accurately measured, and the shoe held from movement around the wheel by a dynamometer. Every precaution was taken to avoid handling the periphery of the wheel or the face of the brake shoe, and even the dust



FIGS. 5 AND 6. THE ELECTRIC BRAKE IN PRACTICE.

was left upon it so as to conform as nearly as possible to the normal conditions of practice.

TABLE II.

| Speed rev. per minute 31 inch wheel. | Brake pressure. | Traction. | Coefficient. |
|---|---|---|---|
| Varying, 150 | 900 lbs. | 87.4 lbs | 9 7 per cent. |
| " 125 | 900 lbs. | 91.7 lbs. | 10 2 " |
| " 100 | 900 lbs | 99 8 lbs | 11.1 " |
| " 78 | 900 lbs. | 118 lbs | 13.2 " |
| " 56 | 900 lbs. | 133 lbs. | 14 8 " |
| " 38 | 900 lbs. | 150.4 lbs. | 16.6 " |
| " 20 | 900 lbs. | 154 lbs. | 17.1 " |
| " 4 | 900 lbs. | 174.6 lbs. | 19.4 " |
| Constant, 105 | 300 lbs. | 29.4 lbs. | 9 8 " |
| | 500 lbs. | 50.5 lbs. | 10 1 " |
| | 750 lbs. | 91 lbs. | 12 " |
| " 100 | 1 150 lbs. | 125 lbs. | 11.2 " |
| | 1,500 lbs. | 178 lbs. | 12 " |
| | 2,200 lbs. | 303 lbs. | 14.4 " |
| " 94 | 3,780 lbs. | 488 lbs. | 13.2 " |

Tracing our 180 pounds application to the brake beam with allowance for loss by friction, we have 3,840 pounds applied to each of the two shoes, which upon the chilled surfaces are found under ordinary circumstances by Table II. to give a coefficient of about 12 per cent. This would give a retarding effect of 460 pounds, which is less than one-third that easily obtainable were the power needful for its application at hand. The coefficient under these conditions must have been about 37 per cent. to realize anything like the total value of the retarding effect of the wheel. This under condition of chilled and glazed surface is entirely out of the question, showing at once the necessity of power in the application of brakes, if anything like their full value and use is to be obtained. This is also amply borne out in practice, as those who have tested this point well know that under ordinary conditions it is next to impossible to slip the wheels of a motor car by the hand brake.

In the electric brake, on the other hand, the fact that the truck parts are not bound up and locked into a solid mass by the enormous pressures of the heavy brake levers and shoes is found to prevent racking and straining the truck as well as jumping the track and curves when the brakes are set. The axles and truck parts are perfectly free for easy and normal movement even when the brake is exerting its full power. Great reduction of wear at the pedestal journals is also found, owing to entire absence of all of the usual heavy pressures of the brake shoes. We can all see that by applying adequate power and control to the wheel brake, this element of the equipment may be raised to the position of an indispensable safeguard, the value of which can only be appreciated as its hitherto undeveloped resources are brought out, demonstrated and rendered simple and easy of application and control. In practice the greatest necessity for maximum brake application exists at the higher speeds. From Table II. it will be noticed that at just this point the failure is greatest, the coefficients being least, increasing as the speeds decrease. This has always constituted the one

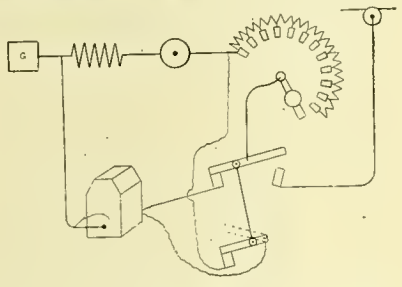


FIG. 7. THE ELECTRIC BRAKE IN PRACTICE.

grave fault of the air brake in railway service. The intensity of its application should be greatest when the speed is greatest, and decrease as the speed drops off. As will be shown farther on, this point has been fully covered in the electric brake, which is the first time that the varying application has ever been embodied in practice, and especially in such a manner as to perform its important function automatically.

A plan, especially one pertaining to electrical matters, after having been proven mathematically to be feasible, is far from being realized. Many are the practical difficulties to be surmounted before a thoroughly commercial or anything like a standard apparatus has been produced. Especially is this true in the electrical field. Many subtle influences and energies are at work which well nigh overwhelm the experimenter. In a new field but few precedents are at hand, and these are apt to be extremely unreliable and in the nature of a blind leader of the blind. The practical application of the electric brake, although probably no exception to the general rule, amply illustrates the wide distance to be spanned between the conception of the idea and the commercial apparatus itself. For years the writer has believed that electricity was vastly preferable to any other force for the application and control of brakes. Working first on the solution of the continuous brake problem for railway trains, he built his first electric brake apparatus in 1882, and has studied and experimented on the problem in its various phases almost continuously since that date, with more or less encouragement in the line of substantial progress. As to its application to electric cars, the apparatus was successfully applied on some double truck cars in Illinois, one of these cars weighing as much as 12 tons. The first equipment, similar to that shown in Fig. 4, was constructed some five years since. This apparatus has been constantly undergoing alterations, and has been experimented with until for the past 18 months a constantly increasing number of electric cars equipped with it have been in regular service, some of these running with change of motormen on each of 13 daily trips, the same motorman having the car once in about three days, making it impossible for the men to become familiar with the operation of the brake. During this time one car has made upward of 70,000 miles, hauling a trailer about 48,000 miles, during some special weeks of test, making from 178 to 220 miles daily. It is only under such rigorous conditions of actual operation that rapid progress can be made in reduction to practice. All machinery or apparatus must pass this ordeal successfully before it can be brought into thorough commercial shape.

At the mention of electric brakes the engineer at once admits that they should be entirely feasible, and usually adds that there is plenty of electrical energy at hand from the central station to retard and control as well as to propel the car. This, however, is not the method undertaken by the writer. To employ the central station current for operating the brakes would be to limit very materially their usefulness and certainty of operation. The braking current, although used at comparatively infrequent intervals, and

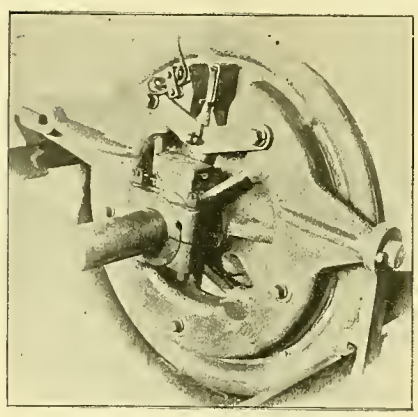


FIG. 8. THE ELECTRIC BRAKE IN PRACTICE.

then only for a short period, should for this reason be absolutely certain and unfailing in its action, and not subject to any "heart failure" of the central station, or sudden cessation caused by the opening of the circuit breakers, the interruption of the line, the flying off of the trolley, failure of the fuse, or failure at other more or less vulnerable points. The electric brake under discussion has been operated over a year on equipment upon different roads, from electricity generated independently of the trolley connection, the braking current not being derived from the central station, but produced by the power of the moving car, which power it is desired to get rid of or destroy. The brake thus operates equally well with the trolley off, and, as will be understood from the following description, the trolley current has nothing at all to do with the car while the brake is being operated, except possibly to maintain the light circuit. The electric brake at the same time is entirely independent of the hand brakes, which may or may not be present upon the equipment. The braking action being altogether independent of the ordinary brake shoes, it is not found necessary to employ them in connection with the electric brake, although in the earlier forms they were used, and in the case of trail cars, especially in heavy service and on grades, some engineers prefer to use them at the present time in connection with apparatus such as shown in Fig. 4. The current employed by the writer for operating the brakes is developed by automatically turning the motor or motors into generators. As these are driven forward by the moving car they develop current which is controlled as to intensity by the starting rheostat of the car. The braking current is thus produced at the expense of the mechanical energy stored up in the moving car, which, being consumed, causes a retardation and final stopping of the mass as a whole. The current so generated may be furthermore led through a brake magnet, as above seen, to apply the brake shoes; it may arrest the motion of the car direct by magnetic adhesion, or develop heavy retarding currents in the moving metallic mass by magneto-induction. When an active local circuit is used the latter method is usually employed for reasons which will be made more apparent.

In developing this system the point which seemed fraught with the most difficulty, and which has finally received the simplest solution of any in connection with the problem, was that of obtaining always and with absolute certainty sufficient current at the lowest speeds without the aid of the trolley current. Teaser coils were at intervals resorted to, maintaining connection with the trolley circuit. "Artificial teasers" were also used, being a device by means of which the trolley circuit was entirely done away with, and which worked well. Observations made from time to time in connection with these experiments led to an exhaustive investigation of residual magnetism, in consequence of which structural means were adopted to utilize to the full the residual magnetism of the motor. This supply is constantly being renewed with every energizing of the car. This method was found to be the simplest as well as the most effective. The connections and in fact the whole arrangement of the electric brake upon the car, is extremely simple. This is shown by the fact that only one small extra wire

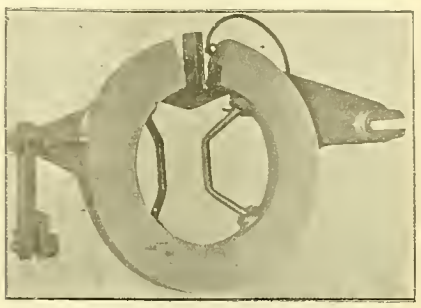


FIG. 9. THE ELECTRIC BRAKE IN PRACTICE.

needs to be run to the controller in addition to the ordinary wiring of the standard equipment without the electric brake. The certainty of operation is evinced by the fact that at present writing over 150 of the equipments have been placed, which are making upward of 10,000 miles daily in regular service. Early in the experimentation a phenomenon was observed in reference to the persistence of the current even after the motor had stopped. This is due to slow action of the decreasing magnetization, taken together with the reaction or self-induction effect of the fields and any brake coil or coils that may be in the circuit. The movement of the magnetic lines, which persist after, and in fact long after the motion of the motor has ceased, generates potential. In many instances it is possible to draw an arc from the rupture of the brake circuit one second after the motion has ceased, showing the presence of current in the local circuit. Fig. 5 has been developed from the average stop to show the curve of current in reference to the motion, the black line indicating the period of motion during the application of the brake, and the curve indicating the current intensity and its duration. The current flowing after motion ceases, though small, is found exceedingly useful in holding the car from starting itself, even on quite a heavy grade, as only a small quantity of energy added to the already great friction of quiescence will prevent the car from starting. This persistency of current is also found useful to kill or destroy the magnetism of the brake magnet, in case it is desired to suddenly move the car forward again. The tendency on the part of the windings at the moment of rupture to generate an opposing electromotive force tends to suddenly free the magnet from its face, a purely accidental feature, which is of great value and utility in this connection. The wonderful energy of the withdrawal of the lines of force being in its manifestations a phenomenon of magnetic viscosity, is illustrated by the following fact: With a perfectly dry track, a great force is required to shear the adhesion and start the wheels slipping. A car going down a grade under these conditions, where no brake magnets are present, will, with a sudden application of the electric brake, generate sufficient current to not only arrest the motion of the wheels, but start them going in the opposite direction, the reverse motion being maintained through an interval truly remarkable, in some instances running as high as one and one-half seconds. It will be borne in mind that all the above phenomena are entirely independent of the central station current, the trolley connection having been severed before the brake is applied.

The current required to be developed to stop a car when no other braking apparatus is used, is found to be only a

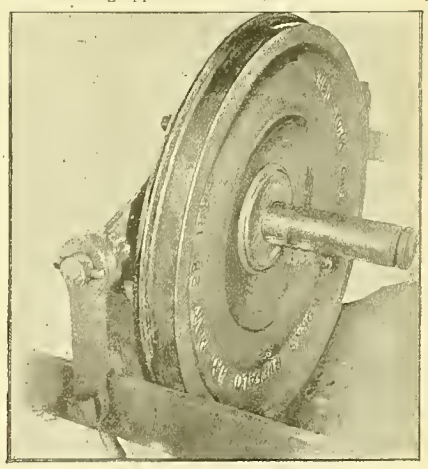


FIG. 10. THE ELECTRIC BRAKE IN PRACTICE.

fraction of that required to accelerate the car in the same interval. This may be easily illustrated by the lines in diagram Fig. 6, *A* being the electrical energy applied in a given acceleration, *B* the resulting mechanical energy stored in the car after deducting all the wastes in the motor, and between the motor and the momentum; *C* the average mechanical energy in the car at the time of applying the brake; *D* being the electrical energy required to be developed for retardation after the efficiency losses have all been provided for out of the quantity *C*. Thus it will be seen that the so-called efficiency losses act in a two-fold sense between *A*

and *B* and between *C* and *D*, to reduce the amount of current required to be generated for braking purposes.

As to the effect of the electric brake on the total temperature of the motor the following experiments were made: A car and trailer were operated over the line in regular service 41.1 miles without the brake. The temperature of the atmosphere was noted every half hour during the test, and the temperature carefully taken of all parts of the motor at the end of the run. The succeeding day a similar run was made with the same trailer over the same track and in the same length of time, but with the electric brake in use, braking direct on the simple local circuit without brake magnets. The difference in the average atmospheric temperatures during the two days was six and one-half degrees, and the difference in the average temperature of the motor parts was seven degrees, making only a difference of one-half of one degree Centigrade as the total increase of temperature from the use of the brake. Observations in reference to the heat in the rheostat were made, although no temperatures were taken, and no difference could be observed in reference to the heating of this portion of the equipment. The explanation will be found in

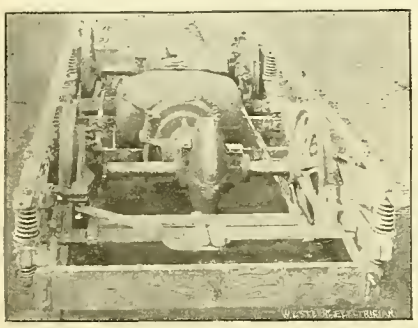


FIG. 11. THE ELECTRIC BRAKE IN PRACTICE.

the comparatively small amount of current as seen above, and the relative infrequency of its application, and short duration at the time of each application. The following wattmeter readings have also been taken:

| | 1st Trip. | 2d Trip Trailer. |
|---|---|---|
| Reading of wattmeter, leaving Lake View.... | 392,538 9 | 392,542.25 |
| Reading of wattmeter, end of round trip..... | 392,542.25 | 392,547.1 |
| Number of full stops. ..... | 55 | 53 |
| Number of slow-ups..... | 42 | 37 |
| Time..... | 1:40 | 1:33 |
| Difference in reading. .. .... ..... | 3.35 | 4.85 |

Constant of wattmeter equals "22:" total watts both trips, 180.4.

Fig. 7 indicates the connection of the wattmeter in the circuit.

Automatic resistances were even at one time used in the endeavor to relieve the motorman of all responsibility in connection with the control in applying the brake, but superlative simplicity was found to be much more desirable than the superlatively automatic, and the automatic devices were seen to be entirely unnecessary, the apparatus as at present constructed being of great simplicity.

The diagram of the braking current in Fig. 5, shows the automatic decrease in the intensity of the brake application so desirable with the decreasing speed referred to above. As the speed decreases, the generator runs more slowly and consequently produces less and less current.

With this style of brake, the life of the wheels is increased from two to three-fold, thus affording a saving in the item next in cost to the electric maintenance itself, to say nothing of the entire saving in brake shoes. This is emphasized in the fact that the brake shoes are being constantly besmeared with sand and grit thrown from the wheels, and when in this condition they are brought against the wheels with the tremendous pressures noted above. A better method could hardly be devised for reducing both wheel and shoe. We little realize the great number of brake applications necessary in a day's run. Careful record has been kept of this point, giving in three days an average of 1,377 brake applications per day for a run of about 164 miles.

Another interesting feature in this connection is that a flat wheel from skidding is an impossibility. It will readily be seen that should the wheels stop, the generator connected with the axles ceases to produce current, and none therefore exists to further apply the brake, and though they may be sliding forward on the rail, yet the wheels continue to rotate more or less, and constantly present new surfaces for the sliding contact.

The braking action is two-fold and is especially efficient. The rotating armature of the motor, instead of tugging ahead by its momentum, is itself pulling back and more or less powerfully braking the car through the gears by the retarding effort of the magnetism of its field while generating the braking current. The power required therefore to perform this work is taken from energy of the moving car which it is desired to destroy; not only is the car thus retarded, but the electric brakes arrest the motion of the wheels direct, with a force that is remarkably powerful and under perfect control of the motorman.

Two forms of braking magnets are used, one for winding up a brake chain usually employed in connection with the trailer, shown in Fig. 4, and another for directly arresting the motion of the axles, one magnet only being used in connection with each axle, as shown in Figs. 8, 9 and 10. These magnets are truck-mounted, not an ounce of their weight being directly on the axle, and are so supported that their gravity acts to automatically retract them from the brake face. (See Figs. 10 and 11, the latter showing the link standing out of the vertical.) The brake face is automatically lubricated to a slight degree, receives a high polish and does not cut or rapidly wear. The brake is noiseless in its operation. It will be seen from the cuts that inasmuch as it does not revolve, no commutating or contact device is necessary. Its crescent form accomplishes important technical functions and also eliminates the necessity of pulling off a wheel for its attachment, removal or inspection. The brake is shown in position on truck in Fig. 12. Its face is solid unbroken metal with no grooves or interstices for catching grit or sand, which in part explains the absence of wear above referred to. The brake magnet is practically indestructible, a few turns of stout wire constituting its one coil entirely enclosed and sealed in metal. No harm nor moisture can reach it. As to moisture, it is immaterial, as the electromotive force at which it works is extremely small, seldom reaching six volts. The lubricator for the brake surface is dry, not sticky or adhesive, and does not gather sand or dirt and retain it upon the braking face. No mechanical pressures whatever are employed to arrest the car, and hence no strain or shoulder-wear comes upon the journals. In constructing the brake magnets their proportions and the arrangement of the magnetic circuits received considerable study. It was during some preliminary experiments that an unexpected phenomenon was noticed; namely, that the retarding effect, when speed is an element, is very much more than would have been expected from the coefficient of friction due to magnetic attraction or adhesion, this latter being a known and definite quantity. Further experiment, made to ascertain the cause, showed it to be due to Foucault or eddy currents set up in the masses. The conditions and structure of the brake magnet were therefore varied in a number of particulars, especially such as would be expected to give the greatest result in Foucault currents produced. The result was immediately successful. It was found that the retarding effect of the brake magnet is due very much more to the generation of these currents than to the direct effect of the coefficient of friction resulting from direct magnetic adhesion, the amount of which I find can be relied on accurately when employed by itself. Some of the forms of brake magnets experimented with were provided with numerous poles of opposite polarity, which were worked upon three different kinds of armature, two of which had radial teeth of different number relative to those in the magnet, and one being a plain disk armature. The toothed armature, while it causes a series of sudden jerks and is also unsatisfactory in the total retardation resulting from a given input, is found also upon rupture of the magnetic circuit to impart to the magnet coil certain counter electromotive forces which materially cut down the current supply and thus the capacity of the device. A magnet formed of a continuous disk with an annular groove sunk in its face is found to give very satisfactory results, but is much heavier and requires an armature twice as heavy for a given number of lines as the double circuit magnet shown in the figures. Furthermore, the relative rotation between such a magnet and its armature affords no point in the masses where the lines are interrupted or changed, and the Foucault currents or reactionary effect set up are very much inferior to those in a magnet where a gap or cessation of magnetic stress is continuously produced. As a result of these investigations the crescent form shown in the figures has been adopted, the opening in the crescent giving the effect referred to, as well as affording an excellent method of attachment and removal of the brake magnet, and at the same time supplying a gap for easily reaching the face for inspection and lubrication. A lubricator, Figs. 8 and 9, is shown as occupying this space. The belief that the extra retarding phenomenon is that of Foucault or

FIG. 13. THE ELECTRIC BRAKE IN PRACTICE.

other eddy currents is borne out by the fact that a conducting lubricant such as graphite is found to considerably increase the effect, also metal filling between the polar faces is almost indispensable for the best result, while at the same time effectually protecting the coil from all damage. These observations would seem to indicate that the eddy currents, however produced, circulate in both masses near the surface, and traverse back and forth across the air-gap whenever ample provision is made to allow them so to do. The practical value of the combined action of all these forces, in increasing the retarding effect, results in necessitating but a small magnet and a smaller current expenditure considering the work performed.

By reference to table III. the result in retardation gained through the eddy or other currents may be plainly seen, column A indicating the retarding effect which should be expected from a friction coefficient of 10 per cent. between the lubricated surfaces due to magnetic attraction of the lines actually circulating, and column B indicating the values of retardation actually obtained on the dynamometer.

That the important positions and trying circumstances under which the motorman often labors are appreciated may be seen by the space devoted to it in the daily press. An editorial in an evening paper reads thus:

One trembles to think what consequences may follow if a motorman gets rattled or has a fainting fit when trying to wind up his hand brake in time. Muscles grow weary and relax at a critical time Even when a man is in fine working condition the strain upon him is severe when compelled to handle the grip lever or current controller and hand brake simultaneously.

As to the arrangement for application and control of the brake by the motorman, about a year ago the following appeared from the pen of the author:

Considering the inexperience of the operator and the responsibility which at times well nigh overwhelms him. I think that, as engineers, we should be willing to set a very high mark to be attained in the ideal brake for electric street railway service, namely: the use of but a single controlling handle for everything; starting, accelerating, retarding and braking the trailer. or trailers and all. Let the motorman have nothing to think of except one handle and two-thirds of the accidents now occurring will be prevented. Let this

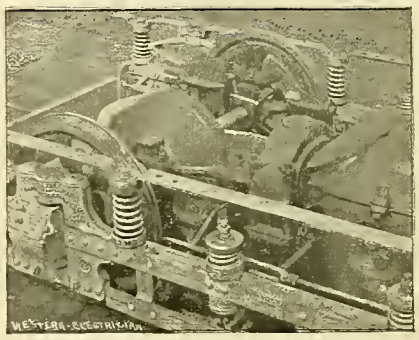


FIG. 12. THE ELECTRIC BRAKE IN PRACTICE.

handle require no more exertion in its operation than the present controlling handle. Let the motorman fulfill his function with as little physical exertion as possible; he will then have a greater reserve for mental application when necessary. A motorman required to exert an enormous amount of brute force, constantly grinding at the brake, has but little life left to apply in case of emergency. I agree with a prominent writer on this subject, where he says that a multiplicity of handles is fatal in time of emergency.

At the time the above was written, equipments controlled as therein set forth, namely, by the use of a single controlling handle for everything, had been in operation for upward of a year. The methods employed for accomplishing this have been varied, but the form most in use at the present time is that shown in Fig. 13, where the resistance contacts are employed in a two-fold manner; the controller handle is made to operate back and forth over the same contacts for controlling both the application of the current to the motor and braking the car. A self-correcting and interlocking device is also provided, shown at *A*, *A'*, Fig. 14, so if the motorman does not throw the handle clear over, the transformation is completed automatically before the movement of the lever can reach the operating contacts.

TABLE III.

| Amperes. | Volts. | "A" Pull due to magnetic adhesion or traction. Friction coefficient per cent. | "B" Pull on brake chain obtained. Graphite lubrication. |
|---|---|---|---|
| 5 | 1 | 7.6 lbs. | 125 lbs. |
| 9 | 1 8 | 18 3 lbs. | 300 lbs. |
| 9.5 | 1.9 | 36.4 lbs. | 608 lbs. |
| 15 | 3 | 121 lbs. | 1,976 lbs. |
| 16 | 3 2 | 149 lbs. | 2,432 lbs. |
| 20 | 4 | 158.4 lbs. | 2,584 lbs. |
| 23 | 4.6 | 167 lbs. | 2,736 lbs. |
| 25 | 5 | 186 lbs. | 3,040 lbs. |
| 31 | 6 2 | 207 lbs | 3,383 lbs. |
| 35 | 7 | 214 lbs. | 3,490 lbs. |
| 35 5 | 7.3 | 214 lbs. | 3,500 lbs. |
| 41 | 8.5 | 223 lbs | 3,650 lbs |

The assumed values are based on a traction of 28.26 lbs. per square inch for 45,000 lines per square inch, being the assumed values at the knee of the curve easily recognized as occurring between 16 and 20 amperes in the table

At one point where a number of equipments were started last summer a newspaper correspondent described the operation of the brake as follows:

The connecting beam was taken from the trolley wire several times and the car brought to a sudden stop with the electric brake alone, within three-quarters of a car length. And it was not a sharp, jerky stop but something as if the car had run into a big feather tick.

The smoothness of even a sudden stop by the electric brake is quite aptly described by this droll statement. It seems as though the car were running into an air cushion.

It will thus be seen that the brake is automatic and does its work without any special act or even the knowledge of the motorman. He simply "works a single handle" back and forth and electricity "does the rest." Suppose the motorman wishes to stop his car, he turns off the current by simply swinging the lever over to the right. This operation is made to automatically convert the motor into a special dynamo for generating currents at very low speeds, and also simultaneously to cut off all connection with the trolley current. The brakes are then applied by simply swinging the handle back over the path it has just traversed; the farther it is swung to the left, the stronger the brakes are applied. The act of releasing or letting off the brakes again automatically re-establishes connection with the trolley and reconverts the dynamo into a motor. Fig. 15 shows the switches used in part for the conversion of the motor, and also the finger *F* mounted upon the lever forming a part of the alternate stroke-operating device. The trolley brake-switch *B* is shown open in Fig. 14 and closed, with dimensions, in Fig. 16. The same rheostat and contacts are applied to control the motor while running the car,

and also to control the slight amount of current generated by the transformed dynamo, which is sufficient to brake the train.

The motorman cannot turn on the current before the brakes have been released, nor can he apply the brakes before the current has been turned off. This is a result of construction, and constitutes a feature of merit in the new electric brake, effecting an economy in current and a saving in wear and tear. Freeing the conductor of all care in this connection, and leaving the braking of the train—including trailer or trailers and all—solely in the hands of the motorman, by placing at his command a power with which he may with the utmost ease accomplish his task, constitutes an important advance in the art of control of electric railway equipment.

It has been found that the electric brake is practically incapable of abuse by any motorman—an advantage which never before has been attained in any power brake, due to the fact above named that no amount of over-application can cause flattening of the wheels, or any harm whatever to any part of the equipment through locking and skidding.

The application of the brake, its regulation and also the running of the car, all by a single operating handle, is a result that has only been accomplished by the closest application. It has involved much pioneer work, and been rendered possible through the use of new mechanical movements original with the writer. The principal moving parts are simple and durable, being only two in number. The arrangement may be easily seen in the controller and parts exhibited, as well as in Figs. 14, 15 and 16. The various portions of the controller have been subjected to the severest tests possible, one test made in 1893 consisting in 518,700 consecutive brake applications without appreciable wear, the parts being in regular service at the present time. An indicator at the right side of the controller at the top, shown at *I*, Figs. 13 and 14, tells when the controller is in condition for brake or is being so used.

Operating the brake in this manner, it will at once be seen that the system is one of the utmost certainty of operation, surer even than the hand brake, air or other power brake, from the fact that every time the car runs, the motor, which is depended on for the braking action, receives a test, and its fitness and capacity for the next brake application is constantly being demonstrated. On the other hand the motorman never knows whether his hand brake is sure to operate when called upon for the next application. An accident came under the observation of the writer on Case avenue hill in Cleveland. Here the last hand brake application was successful in every way, but before the brake was called into action again a nut dropped off from a brake rod upon the truck, rendering the brake useless. The motorman continued to wind on his brake staff, and before he realized what the trouble was, his car was going at a tremendous speed into a short curve at the foot of the hill. There were a number of casualties and also six demands for damages as a result. With the air or other power brake, this liability to failure is increased in direct proportion to the complexity and number of parts.

The advantages found to result from the practical use of the electric brake as compared with former brake systems; its qualities as an accident preventer, as well as its general commercial value, may be recapitulated as follows:

1. The certainty of its operation.
2. The enormous power at instant command and under perfect control.
3. The absence of all power absorption at moneyed cost from the central station.
4. Its high efficiency, being far superior to compressed air; amply proven in numberless instances where electricity

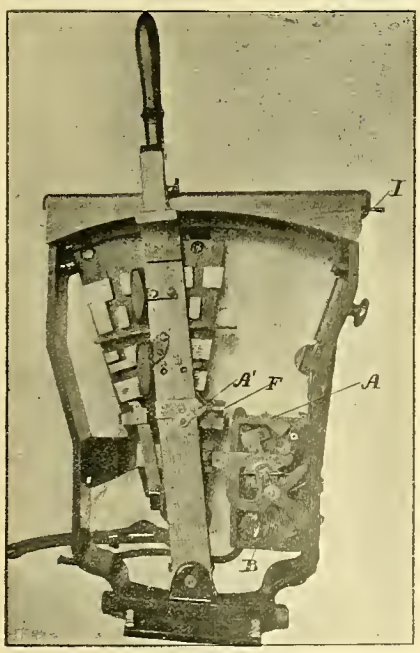



FIG. 14. THE ELECTRIC BRAKE IN PRACTICE.

has replaced air. (The air requires a direct application of energy, amounting to an immense aggregate power absorption during the day from the central station; the working parts of the air machinery are attached to the car axles and require a large quantity of energy, not only while compressing, but at other times as well.)

5. Its extreme simplicity.
6. Observed saving in wheels, two to three old.
7. Entire saving in brake shoes.
8. Lubrication of brake face; very little wear of either wheel or magnet.
9. Absolute silence of operation and release. No hissing to frighten horses on streets.
10. The low electromotive force at which it operates.
11. The ease of its application and control.
12. Conserving strength and prolonging the usefulness and life of the motormen.
13. The smoothness of its operation.
14. The fact that its use cannot cause flat wheels.

## Electricity and Animal Life.

Aside from analogies and figures of speech, and not counting the so-called "animal magnetism" of Mesmer, which is possibly a psychological and not a physiological phenomenon, there seems to be some curiously intimate relation between life and electricity, which biologists have been investigating for forty or fifty years. A recent review of these inquiries in *Science Progress* shows that there is some disagreement as to facts, and still more as to explanations; but even in this incomplete state of development the subject is an interesting one, says the *New York Tribune*.

Experiment thus far has been chiefly confined to the glands of the skin of frogs and other animals, to salivary glands, the stomach lining and various other mucuous membranes; but these tests have been quite numerous, and carried on with many modifications. In the first place, it appears that during a great part of the time various glands, while in what may be regarded as a state of comparative rest, nevertheless generate enough electricity to be discernible with delicate instruments, and this current usually has an inward direction. If, though, some external stimulus be applied to the gland, there is apt to be a reversal of direction, or a lessening of the intensity of the "current of rest." Abstraction of heat, imbibition of water, painting with various drugs, interference in blood supply to the organ, and changes in the kind and quantity of the stimulus, vary the result. In human subjects tickling, mental effort, sound, the expectation of sound and pungent odors produce sensible effects, if electrical connections be made between some part of the skin, like the palm of the hand, relatively rich in sweat glands, and regions poor therein.

Two theories have been advanced as to the cause of this occurrence. Bayliss and Bradford attribute the phenomenon to the flow of fluid in the secreting mechanism, which is scarcely more than friction. It is known that the movement of water in cells and ducts does produce current in

FIG. 15. THE ELECTRIC BRAKE IN PRACTICE.

other cases, with porous diaphragms and in plants; but some of the observed facts apparently contradict this supposition, when applied to animals. The other principal explanation is that changes in metabolism, one way or the other, lie at the root of electrical variations in life. "Metabolism" is a word which biologists use to designate two classes of action in the protoplasm of the cells which make up animal tissue. One, anabolism, is constructive. It takes material out of the blood and builds up the cell therewith. It stores and strengthens. Katabolism, on the other hand, converts this accumulated and manufactured life-material into a separate substance—sweat, saliva or something else—to be thrown off. This process is destructive of protoplasm. Biedermann regards the process of secretion in a gland katabolic, and as explaining the in going "current of rest," while anabolism he regards the cause of the cut-going current.

For a further elucidation of this subject, it would be natural to look to those marine creatures which develop electricity to such a degree as to paralyze their prey with a shock or succession of shocks. Little headway has yet been made, though, in that direction. Fritsch, says the *Science Progress* reviewer, held that the organ of the electrical shad, found in certain African rivers, is composed of glandular cells derived from the overlying skin. In this fish, as also in the electrical ray and eel, moreover, the action of the organ is voluntary and under the control of the possessor. The activity, being more intense, is susceptible of more careful study, while the part which the will plays in the manifestation gives the latter a new value. It is hard to avoid the belief that further exploration of these phenomena may reveal something regarding the higher functions of life, volition, mentality and perhaps moral operations, in addition to the purely physical.

## Resolutions Adopted Upon the Death of Chas. H. Rudd.

The Association of Practical Electricians, Chicago, has adopted resolutions of condolence upon the death of Charles H. Rudd, who died recently from injuries received in an explosion while experimenting with one of his inventions. Mr. Rudd was an honorary member of the association, and his death is a source of sincere regret to his friends.

It is said that electric freight cars will be run over the line between Albany and Troy by the first week in October. The freight cars are painted brown with light trimmings, and will carry ten tons. Inside they are finished in light wood highly polished, and are lighted by four incandescent lamps. There are four doors, one in either end and side.

## Convention of the National Society of Electro-therapeutics.

The second annual convention of the National Society of Electro-therapeutics was held in New York last week. A number of interesting papers were read upon the application of electricity to the practice of medicine. Boston was chosen as the next place of meeting, and the following named officers were elected: President, Dr. William L. Jackson,

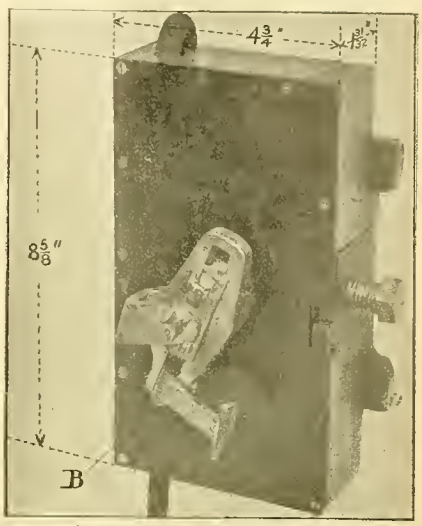



FIG. 16. THE ELECTRIC BRAKE IN PRACTICE.

Boston; first vice-president, Dr. E. S. Bailey, Chicago, Ill.; second vicepresident, Dr. F. A. Gardner, Washington, D. C.; secretary, Dr. Clara Gary, Boston; treasurer, Dr. J. B. Garrison, New York; members of executive board, in addition to the preceding officers, Dr. W H. King, New York, and Dr. M. D. Youngman, Atlantic City, N. J.

## Moonlight Schedule.

Following is the WESTERN ELECTRICIAN's lamp lighting schedule for October:

| Day of Month | Light. | | Day of Month. | Extinguish. | | Number of Hours. |
|---|---|---|---|---|---|---|
| | | H M | | | H M | H.M. |
| 1.... | P. M. | 6.10 | 2.... | A M | 5.0 | 10.50 |
| 2.... | " | 6 10 | 3 .. | " | 5 00 | 10.50 |
| 3.... | " | 6 50 | 4.... | " | 5.00 | 10.10 |
| 4. .. | " | 7 30 | 5.... | " | 5 00 | 9 30 |
| 5. .. | " | 8 30 | 6.... | " | 5.00 | 8 30 |
| 6... | " | 9.20 | 7.... | " | 5 10 | 7.50 |
| 7... | " | 10.3 | 8.... | " | 5 10 | 6.40 |
| 8.... | " | 11 30 | 9 ... | " | 5.10 | 5 40 |
| 10.... | A. M. | 12 40 | 10.... | " | 5 10 | 4.30 |
| 11.... | " | 1 40 | 11.... | " | 5.10 | 3 30 |
| 12.... | " | 2 40 | 12.... | " | 5.10 | 2.30 |
| 13.... | No light. | | 13.... | No light. | | 0.00 |
| 14 ... | No light. | | 14.... | No light. | | 0.00 |
| 15.... | No light. | | 15 .. | No light. | | 0.00 |
| 16.... | P. M. | 5 40 | 16.... | P. M. | 7.10 | 1 30 |
| 17... | " | 5.40 | 17 .. | " | 7.40 | 2.00 |
| 18 .. | " | 5 4 | 18.... | " | 8 30 | 2.50 |
| 19.... | " | 5.40 | 19 ... | " | 9 30 | 3 50 |
| 20 ... | " | 5 40 | 20 .. | " | 10 40 | 5.00 |
| 21.... | " | 5 40 | 21.... | " | 12.0 | 6.20 |
| 22.... | " | 5 40 | 23.... | A. M. | 1 20 | 7 40 |
| 23.... | " | 5 40 | 24.... | " | 2.30 | 8 50 |
| 24.... | " | 5 30 | 25.... | " | 3 50 | 10.20 |
| 25.... | " | 5 30 | 26.... | " | 5.00 | 11.30 |
| 26.... | " | 5 30 | 27... | " | 5 30 | 12 00 |
| 27.... | " | 5 30 | 28... | " | 5.30 | 12.00 |
| 28... | " | 5.30 | 29.... | " | 5.30 | 12 00 |
| 29 .. | " | 5.30 | 30.... | " | 5.30 | 12.00 |
| 30.... | " | 5.30 | 31 .. | " | 5.30 | 12.00 |
| 31.... | " | 5.30 | Nov. 1 | " | 5 40 | 12.10 |
| | | | Total..... | | | 212.30 |

The foregoing schedule was calculated on the following basis:

Light one-half hour after sunset and one hour before moonset.

Extinguish one hour after moonrise and one hour before sunrise.

## Old Time Telegraphers.

At the recent reunions of the Old Time Telegraphers and United States Military Telegraph Corps at Baltimore the name of the former association was changed to the Old Time Telegraphers and Historical association. It was decided to admit all telegraphers who have been twenty years in service prior to the date of application for membership, and New York city was chosen as the place of next year's meeting. Officers were elected as follows: President, E. C. Cockey; vice-president, R. J. Hutchinson; secretary and treasurer, Geo. C. Maynard. The officers chosen by the Military Telegraphers were: President, W. R. Plum, Chicago, vice-president, William B. Wilson, Philadelphia; secretary and treasurer, J. E. Pettit, Chicago.

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CORRESPONDENCE relating to electricity or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

CIRCULATION, 16,630.

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IT is a pleasure to note that the first meeting of the street railway association of Michigan, held in Grand Rapids last week, was a success, and that those in attendance separated with the resolve not to miss the pleasure and profit promised for next year's gathering. About half of the electric railway companies of the state were represented at Grand Rapids, and there was a fair sized delegation of supply men. There was an interesting interchange of views and the social features were not neglected. The organization of state associations of street railway men should be encouraged, as such societies, if thoroughly representative, can do more to prevent adverse legislation at the state capitols than the national association itself. We rejoice, therefore in the bright prospects of the recently organized Michigan Street Railway association.

THERE is a good deal of nonsense printed in the New York *World* in the course of a year, but it is safe to say that seldom has there been such an exhibition of ignorance and sensationalism even in that erratic journal as was displayed in the publication of an article criticising the arrangement made by the postoffice department for the handling and transportation of mail on the trolley cars in Brooklyn. The writer of the article in question cries out in alarm that the postmaster of Brooklyn and the trolley companies are "guilty of treason;" that the trolley companies have transferred their allegiance from the state to the federal government, and that the latter has aided and abetted them in their rebellion. The state, through its officers, is called upon to stamp out this rebellion and punish the offenders; and, as treason is punishable by death, it is presumed that nothing short of a wholesale execution will satisfy this bloodthirsty contributor. The fact that the arrangement complained of makes an attack upon the trolley lines or interference with the operation of the cars a serious offense, seems to be the only reason for this display of indignation. Such an article could only find place in a paper of the character of the *World*.

ATTENTION is directed by the executive committee of the New York State Street Railway association, in its annual report, to the importance of enlisting the services of every company in the state in the work which it has undertaken. Not the least important work which this association has taken up is the protection of street railway companies against adverse legislation. The association employs a lawyer to watch every measure introduced into the Legislature that may affect the interests of the street railway companies of the state. In case these interests are threatened it is customary for the members to use their influence with local representatives to protect themselves and their associates. The committee calls attention to the fact that in many cases the officer of a relatively small company has greater personal influence with his representative in the Legislature than a man living in the great city would have. The report adds: "For this special reason, therefore, is your committee desirous of having every street railway company in the state, no matter how small the company may be, a member of the association." The excellent work thus far accomplished by this organization should encourage state associations throughout the country to take a similar course. It is the only practical way to defend their interests.

PREVIOUS to his visit during the World's Fair Mr. Preece had not been in this country in nine years. He found many changes, as might have been expected, and, according to his speeches made on this side, he was simply lost in his admiration of the wonderful things he saw here. But now that he has returned to England and probably sees little prospect of another trip for nine years, he finds some things to criticise and others to condemn. In a discussion at the Institution of Civil Engineers recently, Mr. Preece showed himself a good subject of her Majesty by his explanation of the failure of Englishmen to keep up with modern ideas in traction work. He admitted that the development of the trolley system "in England was small compared with that in the United States. There it was seen not only in all the suburbs of the cities, but also in the great cities themselves; and anything more horrible had never been seen in this world than those wires extending through a beautiful city like Boston, simply covering the principal thoroughfare with a cobweb of a diameter of about an eighth to a quarter inch." Probably when a practical underground system is worked out by Americans our English friends may condescend to utilize it.

AFTER several months of inactivity the Board of Rapid Transit Railroad Commissioners of New York announces that it is now prepared to resume consideration of the interesting problem of providing a complete system of rapid transit that will meet the approval of the people. The board's engineer has returned from Europe after looking into the methods employed in the large cities abroad, and he will make a report of his investigations. Provision must at once be made for the submission to the people of the question of municipal construction, if the matter is to be acted upon at the coming election, as is the intention at present. The Rapid Transit act of 1894 provides that the commissioners must file with the police board at least thirty days prior to election a request for the printing by official ballots for use in the determination of the question of municipal construction. These ballots are to read "For" or "Against municipal construction of rapid transit road." The road which it is proposed to ask the people to vote on is the same underground system agreed on by the old Rapid Transit Commission. The counsel to the commission have decided that these plans may be altered in any particular after the people had decided to build a road at the city's expense. It is feared by many that the problem may be involved in the political controversy this fall and may suffer by reason of the reluctance of many to permit a public improvement of such magnitude and the patronage growing out of it to be placed under the control of political bosses.

MR. SPERRY'S paper before the Institute, which is presented in another column this week, discusses one of the most important topics that have confronted electric railway men. The trouble that has been experienced in all large cities where the trolley has been introduced emphasizes the necessity of employing improved methods for controlling these cars. Attention is called to the fact that the locomotive engineer is provided with complete apparatus for controlling and stopping the train in his charge. "The periods of application are comparatively infrequent, and as to personal capabilities, the locomotive engineer is schooled and trained for years before ever being allowed to touch either the throttle or the air valve. While working, his pressure gauges allow him to adjust the brake application to a nicety. Moreover, the time allowed for the total retardation and final stopping of his train is usually very long as compared with that allowed in street railway practice." It is not to be wondered therefore in view of these facts that the electric railway companies have been forced to consider the necessity of giving this subject closer attention. The fact that many companies have been compelled to pay heavy damages for accidents that might have been averted had the trolley car been provided with efficient brakes, has impressed the importance of the subject on the minds of street railway managers. Mr. Sperry's suggestions should receive careful consideration, and the report of his experiments deserve serious discussion. Further experience will of course be required to convince street railway managers generally of all the claims that Mr. Sperry makes for the electric brake.

GOVERNMENTAL control of enterprises now conducted by private capital does not lead to that ideal condition in actual practice which advocates of this theory claim would follow the adoption of this policy in this country. The facts reported by the Inter-State Commerce Commission, in compliance with a Senate resolution introduced by Senator Pettigrew, show that government ownership of railroads does not pay the goverment nor benefit the people. Statistics compiled by this commission cover ten countries that do not own or operate railroads, eighteen that do and three that own part of the railroads but do not operate them, leasing the lines to private companies. Many experiments have been made, and it has been found unprofitable for the government to engage in these enterprises. In this country several of the states have tried ownership in a limited way. Illinois construced a road at a cost of $1,000,000 and disposed of it for $100,000. Indiana had a similar experience. Georgia owns a railroad, but found it expedient to lease it to a private company. Pennsylvania constructed one from Philadelphia to Columbia, but sold it later. Massachusetts, Michigan, and several other states tried the experiment without success. The facts presented in this report are interesting and valuable and should be studied by men in this country who are advocating state ownership of railroads and telegraph lines and the municipal control of lighting and street railway systems. The statistics thus presented prove that it would increase the cost of service to the public, with no gain in efficiency or convenience, while it would not improve the condition of the great mass of the men employed.

BUFFALO proposes to celebrate the actual consummation, so far as it is concerned, of the project for the electrical transmission of a portion of the power of Niagara Falls by an imposing demonstration which is to take the form of a great electrical exhibition. The city council, board of trade and the citizens generally have taken up the plan with much enthusiasm, and it seems probable that an interesting display will be arranged, although all details of scope, extent, date and duration appear to be as yet unsettled. Buffalo is an enterprising and prosperous city, and as its manufactures will undoubtedly receive a great impetus from the cheap electrically transmitted power of Niagara Falls, it can readily be understood that it desires to make the most of its fortunate location and to "boom" this advantage by an electrical exhibition that shall attract the notice of the whole country. Already the newspapers of the town speak of Buffalo as the "Electrical City," and there are not lacking enthusiasts who assert that the prospective exhibition will exceed in size and attractiveness the electrical department of the World's Fair. The latter statement can hardly be taken seriously, however, since the electrically transmitted power at last year's exposition reached a total of 23,000 horse power, while if the entire capacity of the Niagara Falls plant were utilized to send current into Buffalo—an impossible contingency—the amount must be less than 15,000 horse power. But the Buffalonians need only a fraction of this amount of power to make an important and interesting display, and the exhibition, whatever its size, will possess an unique attraction from the fact that the machinery will be operated by the transformed power of the mighty cataract. The event to be signalized is of great importance, and we have no doubt that the enterprising city of Buffalo will mark it by a celebration in every way worthy.

## Economy of Power House Operation.

By J. B. Craven.

"Economy of Power House Operation" has been so often and so thoroughly discussed that I do not know that I can say much that is new on the subject, and yet being one that must ever come up before the management of a street railway system, I feel encouraged to beg the attention of this meeting for a few minutes, that we may see how and where with intelligent management and proper attention the best results may be obtained on the most economical basis. Starting from the boiler room, we come at once to the place where in most cases the greatest waste will be found. It has been said that the waste due to improper firing is often of greater consequence than any other loss which is produced in operating a steam plant. There are two causes for this: First, poor construction of the boiler; secondly, poor firing and lack of care of the boilers. Most of us think that any man can fire a boiler, and while looking with awe and wonder at the engine and generator, forget that all the power comes from the coal pile and pay little attention as to the economy in transmitting that power from the coal to the engine. No greater mistake is made than to place the care of boilers in incompetent hands, for they require the highest degree of care, conscientiousness and constant attention.

The fireman must be ever on the watch to see that the water is kept at the proper level, to keep an even steam pressure, and to show by his steam, coal and water records that he is getting just as good cards as the engineer can show by the manipulation of the steam he uses in his engine. He must see that the fires are spread evenly over the grates and are of an even thickness; that the proper amount of air is admitted into the furnace to obtain good combustion.

If you could realize how easily from 1 to 20 per cent. of coal can be shoveled into the furnace and up the chimney without generating any more power, you would see how essential it is to have something more than mere machines shoveling coal into a furnace. Another point of importance is to see that boilers are kept clean and free from scale, which is simply the result of improper attention.

If for a moment you will stop and think that in the construction of the boiler, the maker has reduced the thickness of the tubes as much as possible consistent with safety, and then look at a tube with from one-eighth to one-half an inch of scale on it, you will at once see how great the loss must be transmitting the heat through this scale; not only that, but it leaves the iron exposed to the effects of the heat without the proper circulation of water back of it, which causes rapid deterioration, and in some cases is liable to cause an explosion. I have used quite a number of boiler compounds for the prevention of scale, but have found the best to be plain coal oil. We have used it in Buffalo for the past two years with success, putting about one pint a day into each boiler and letting it enter with the feedwater by means of a sight feed lubricator. However, no one remedy will fill all cases, and each must be the subject of some experiment.

Another source of loss comes from insufficiently covered boilers and pipes; see that all exposed parts, that possibly can be, are covered with some good non-conducting material, and prevent as much as possible radiation and condensation. The steam pipes should be kept tight and all leaks followed up at once and stopped, and in this way have as little loss as possible between the boilers and engines. See that the piping is well drained, so that water will not carry over to the cylinder of the engine. This is accomplished by separators placed as near to the engine as possible, and the water thus separated is returned to the boilers. In a good many cases this water is allowed to go to waste; if this is found to be the case it should be remedied, as this water is separated at a very high temperature, and requires very little heat to turn it again into steam. Before entering the engine room, I would like to say something on the subject of feedwater heaters. If your engines are running non-condensing, the question is very easily settled; as, however, the majority of steam plants are run condensing, other factors are brought in. In the power house of the Buffalo Railway company, one-seventh of the engine capacity is run high pressure. In this way, taking the feedwater from the hot well, at an initial temperature of 110 degrees, and passing it through two heaters in the exhaust line of the high pressure system, we get a final temperature of 194 degrees before the water enters the boilers. It is claimed by some that this method of taking the water from the hot well is not right, on account of the oil to be found in this water. But so small a portion of the hot well water is used, that the amount of oil in it is small, and by this method we do away with secondary heaters in the exhaust line, between the engine and condenser, and not only save in the first cost, but I think obtain slightly better results. However, one thing is important, whatever means are used to heat the feedwater, it should be done, for not only will there be a great saving in fuel, but the straining of the boilers due to putting cold water in will be done away with.

Passing from the boiler room, we come to the engines and generators, and the types seen here will be many and varied, from the high speed, belt-driven machine to the slow speed, direct-connected machine of large units. As you all know, the tendency of late has inclined to the use of the latter type. In my mind there is no doubt of the efficiency of the direct-connected unit over the belted one. It is evident to all that where space is valuable it has the advantage of taking up less room. They can be thrown in and out of service with as much rapidity as the belt-driven machine; there is a saving of from 1½ to 3 per cent. due to the slipping of belts, very little in itself, but when figured up at the end of a year in a plant of any size it will amount to considerable.

Added to this there is the saving of labor and the decreased expense due to wear and tear, as this item is less in slow speed than high speed machinery. For the above reasons I have drawn the conclusion that direct-connected units are more economical than high speed ones. Regarding the size of units used, it depends entirely on the output of the plant. I would advocate as large as possible, yet not so large that the breaking down of one would cripple the output. However, in plants that have not these latest types of machines, great saving may be made in the operating of the engines. In many cases, after the constructing engineer has left, engines are oftimes supposed to look after themselves, those in charge simply supplying them with steam and oil. What I said in reference to the man in charge of the boiler room applies with equal force here. Put a thoroughly competent man in charge and you will find it a paying investment. Intelligence and experience are the best safeguards and the real insurance against accidents. Fifty dollars a month more to a capable engineer will probably be repaid a hundred times by the care taken and the high state of efficiency at which the machinery is kept. In such a state an engine is a reliable piece of mechanism. If neglected it is liable to fail at any time, causing delays and worries, and not only adding to the expense in the cost of repairs, but a loss in the receipts outside.

A capable engineer will see that his engines are indicated at least once a month, to see that the valves are properly set and so keep the steam consumption down to a minimum. All pounding, knocking and leaks should be followed up and remedied at once, and the engines kept in such a state as at all times to be ready to perform the severest service exacted from them. Always keep the load as near the normal capacity of the engines as possible, as engines at that point are most economical; besides, you will have fewer machines in service, and thus save in the oil supply. Here I will say a little on the subject of oil, as I think quite a saving may be made at this point; in fact, I have had one engineer use $640 worth of oil more in six months than another engineer used in the same time, and the engine capacity was increased during the time the last man was in charge. The lowest priced oil is not always the cheapest; some oils will go much further than others, and the question of what to use should be settled only by careful examination. After being used once it can be filtered and used again on the lighter parts of the machinery. If rags are used for wiping instead of waste, they can be washed and used again, and the grease and oil extracted will be found useful in some part of the system. By washing the rags 80 per cent. can be saved over what the cost would be if only used once and thrown away. Coming to the generator, we find a machine that is usually well made and efficient. Keep it dry and thoroughly clean and have the commutator kept as smooth as possible. The principal trouble will be found in the sparking of the brushes and the heating of the armature and the field coils. The causes for these troubles are too many to enter into here; but on the appearance of trouble the machine should be stopped as soon as possible, for the old maxim, "A stitch in time saves nine," can be applied here. Keep the minor electrical apparatus in a station—everything such as switches, connections, and all instruments—clean and in working order, especially in the case of lightning arresters, as they may be the means of saving an armature.

In conclusion I would call your attention to the necessity of having ample copper in the outside lines, and the rails well bonded, and where the system is large enough put in return wires. What is the use of expensive and economical machinery in the power house if you allow 20 per cent. of the power to be expended heating up poor connections in the return circuit?

### Discussion.

Mr. Cole: I would like to ask Mr. Craven if he would advise directly connected engines on small roads, of fifteen or twenty-five cars, where the load is variable.

Mr. Craven: I think I should; yes.

Mr. Seely: In the paper you speak of injecting oil into the boiler. Do you refer to crude or refined oil?

Mr. Craven: Refined oil.

Mr. Seely: Have you had any experience in the use of crude oil?

Mr. Craven: I have not. If you put in the refined oil it reduces the scale from a hard substance into a slime, which is easily blown out, and when we open the boilers, as we do once a month, we find probably one-sixteenth of an inch of hard scale that is broken off very easily. We can clean the tubes in most cases as clean as when they were first put in.

Mr. Seely: Do you inject the oil as you operate the machinery?

Mr. Craven: Yes, sir. We inject a pint of oil in the course of ten hours' run.

Mr. Issertel: The report refers to a road of a certain size using a return wire. How large a road; how many miles would you suggest?

Mr. Craven: That would depend upon the number of cars more than on the length of the road; but a road six miles long, with ten cars, I should say would require a return wire, as well as the bonding of the rails.

Mr. Issertel: The bonding of the rails also, not simply a cross-bond?

Mr. Craven: The bonding of each rail to the next rail.

Mr. Issertel: How large a wire do you use?

Mr. Craven: I should say a No. 0 for the bond itself; but when you commence to put in return wire, it has to be calculated according to distance and number of cars.

Mr. Issertel: You believe in a large return wire under any circumstances, do you?

Mr. Craven: It is brought down to a simple question of calculation. A current requires so much area to return on, and if you do not supply it, more power will be consumed getting the current back to the station.

Mr. Issertel: Yes, but with the rails they are using now, with two bonds, it is unnecessary to use return wire.

Mr. Craven: They cannot do it, for the reason that you are carrying out of your station, say twenty-eight feeders, with a cross-section all the way from a half-inch to an inch, and you cannot expect the current to be brought back on two bonds half an inch in diameter.

Mr. Seely: The cross-section of a ninety pound girder rail has a capacity to carry back current equal to about No. 0000 copper wire.

Mr. Issertel: That is the point; and with four rails bonded together you would have four times the carrying capacity. As it is a matter of a great deal of expense to use the return wire, I do not see why the rail should not be sufficient.

Mr. Craven: I understand it costs a great deal of money to put it in, but if you do not put it in, and do not get sufficient capacity for the return current, you are going to use much more coal to supply the extra demands.

Mr. Seely: In using return wire do you believe that they should be put in conduits, or the rail bonded back in sections? Do you think there is any saving in placing return wire in contact with the earth, or should it be tapped in every thousand feet, and then returned in conduits?

Mr. Craven: In Buffalo we run an underground feeder system, and we are bringing our return wires through these conduits.

Mr. Seely: By that system you have the advantage of the fall of potential from the station to the point of contact of the rail. There is a small loss between that point and the generator. Small roads could not afford that.

Mr. Craven: In cases where they have not an underground system, lay the wire in the ground.

Mr. Seely: And not tap in on the pole?

Mr. Craven: No, sir.

Mr. Seely: It is entirely a question of sectional area; it all comes down to that point.

1. Read at the twelfth annual meeting of the New York State Street Railway association, Syracuse, September 18, 1894.

## Some Storage Battery Phenomena.

In addition to the discussion of Mr. Griscom's paper before the American Institute of Electrical Engineers, reported in the last issue of the Western Electrician, there were two interesting communications contributed by Messrs. Wolcott and Reckenzaun after the meeting. These are herewith presented, together with Mr. Griscom's comments:

Townsend Wolcott: In the paper Mr. Griscom offers explanations for a number of phenomena before unaccounted for, but he also presents a large number of phenomena for which he asks explanations from the other members. I am afraid that the desired information is not forthcoming. I say this because the theory of the storage battery is full of anomalies such as the following:

Take a strip of ordinary sheet lead which has been exposed to the air and become somewhat tarnished, cut it in two and place the halves in the ordinary battery acid and connect with a low reading voltmeter. In the majority of cases there will be a small electromotive force shown, due to the minute differences in the oxidation (tarnish) of the two halves of the same strip. Now by carefully scraping the positive piece, the voltmeter may be brought to zero, after which a little more scraping will produce a deflection in the opposite direction.

This sensitiveness would seem to indicate that there was an exceedingly great propensity to local action in the storage battery, and it would also seem that a lead grid filled with peroxide would constitute a short-circuited couple with an electromotive force of two volts or thereabouts and that when placed in the acid it would completely discharge itself in a short time.

That is not the case, however, every one knows. In fact, if we take two perfectly clean as pieces of lead which give no deflection on the voltmeter, and coat one with peroxide, even on one side, the couple will give a considerable voltage, although it may be below two volts. That is to say, there is, apparently at least, no electromotive force between the peroxide and the lead with which it is in direct contact, while between the peroxide and the lead with which it is connected through the voltmeter there is a very decided electromotive force.

The explanation of this appears to be that there is a strong tendency of the metallic lead and the peroxide to come to the same potential as soon as current begins to flow between them. There is probably a momentary current on immersing a peroxide grid, but it is probably only momentary, even if the grid remains apparently unoxidized. The fact that the voltmeter in the experiment just mentioned remains deflected for some time, with two small strips of lead, would seem to show, however, that an appreciable quantity of electricity passed before equilibrium is attained.

I am somewhat surprised at the results obtained by Mr. Griscom, in connection with the discharge of one plate into another, which was at a low potential. So far as my experience goes, it is rather contradictory to this. I have frequently seen an attempt made to divide the charge between two equal sets of cells, one of which was fully charged, and the other pretty well discharged. The result was always unsatisfactory. The tendency of the electromotive force of a discharged cell to rise quickly above two volts as soon as recharge begins would soon reduce the current to a trifling amount, so that the charges would not be even approximately equalized in any reasonable time.

The presence of peroxide of hydrogen in some cells but not in others is another of the enexplained phenomena which are so frequently met in storage battery work. It may be possible or even easy to construct hypotheses to account for such irregularities, but what is wanted is demonstration and not speculation.

Mr. Griscom: Is Mr. Wolcott confident that the experiment which he details proves the existence of electromotive force due to differences of oxidation? Is it not possible that it is due to occlusion of gases? I have found considerable differences of potential between two plates of chemically clean platinum, one of which had been exposed to the air, after being heated red hot, rather longer than the other.

If two pieces of platinum about one inch square be chemically cleaned, heated red hot and immersed in dilute sulphuric acid, they may be brought to the same potential by a little manipulation. If then one of them be removed again, cleaned, heated red hot and allowed to cool for a few minutes and then immersed in the electrolyte it will at the moment of immersion show a powerful deflection equal to over a milliampere. If, now, the same plate be taken out

of the electrolyte again, cleaned, heated red hot and plunged while red hot in the electrolyte, a very curious phenomenon will be noticed—the first deflection will be negative and immediately afterward the current will reverse and the platinum will resume its positive polarity.

It is hardly credible that the potentials are due to oxidations of the platinum. I am rather inclined to think that it occludes oxygen from the air and possibly it occludes an extremely minute portion of hydrogen when immersed red hot in the solution. It might, perhaps, be worth while for chemists to remember that platinum always absorbs oxygen from the air after being heated red hot and really to an appreciable extent—enough in fact to produce several milli-ampere seconds per square inch under the above circumstances. I have not given careful examination to the behavior of lead under these circumstances, but I must confess that I have not found so great deflections while using lead as I obtained with platinum.

I do not think that there is as much local action in a storage battery as has generally been supposed, if by local action is meant an electrolytic effect due to the paste and grid. That local action must ensue with plain lead coated with peroxide of lead when immersed in sulphuric acid is of course unquestionable, but the amount of action is limited to the oxidation of the metallic lead surface and that oxidation prevents further action to such an extent that positive plates which have been in use for eight years are not oxidized to a greater depth than $\frac{1}{100}$ of an inch, provided the lead was of good quality and not full of minute holes. My own impression is that the loss of energy in a storage battery is due to a different kind of local action, to-wit: that which is caused by the actual differences of potential of different parts of the paste and acid. This difference of potential may be due to different densities of acid in the pores of the active material, or it may be due to different degrees of oxidation of the active material, or it may be due to both factors combined.

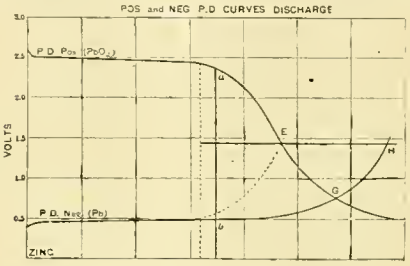
FREDERICK RECKENZAUN: While I had just missed the presentation of Mr. Griscom's interesting paper on arriving at the Philadelphia meeting, I have since carefully perused its contents. Besides various striking points and suggestions, I note some features therein which appear to warrant discussion. First in their order are the curves and data giving observations on the potential difference of the positive and negative plates, wherein the individual plates of another cell, which the author terms "test cell," as distinguished from the cell under test, have been used as the basis of measurement. Why Mr. Griscom should have adopted two separate standards, one for each plate under test, is not convincingly explained, but it is apparent that this selection was not a fortunate one. Owing to the inconstancy of the standard cell (test cell) itself, as shown by its electromotive force curve, the potential difference curves obtained for the separate plates actually represent the resultant values of two unknown and varying factors and not, as they purport, the specific potential variations of the plates under test. Nor could the latter be definitely deduced by allowing for the deviation, from a straight line, of the electromotive force curve of the "test cell" because there is no evidence that the individual plate potentials of the latter varied alike. Such being the case, the characteristics obtained necessarily become somewhat problematical.

In reference to the "continuation" discharge (Faure cell) to which Mr. Griscom attaches special significance, it may be noted that the negative curve is decidedly odd, and the context rather remarkable for its omissions. The negative potential difference curve preceding the "continuation" discharge, if the compensation referred to were made, would undoubtedly be nearer the horizontal than shown, and would be far from indicating a sudden, abrupt break to one volt within the first five minutes of the continuation, and to almost zero in five minutes more; indeed, even taking the curve as it is, which represents the sum of the potential losses of both the standard and the plate under test, it forms an angle with the "continuation" curve which it would be idle to anticipate in an uninterrupted continuation of the discharge, and still more so in an interrupted one, as was the case, unless some very untoward accident or interference befell the plate. We are told that for the continuation test the plates were separated and each opposed to freshly charged plates in fresh electrolyte. We are not told the specific gravity and temperature of the fresh electrolyte, which factors influence to some extent the electromotive force; we are not told why fresh electrolyte has been used instead of the old one or one like it; nor are we told the period of rest that intervened. However, that their combined effect was considerable and favorable to the positive plate is shown by the curve for that plate, in view of which the negative continuation curve appears utterly incredible. Such a state of the negative, one might expect if it had been allowed to discharge, as by a short-circuit or exposure to air (followed by a momentary recuperation in the electrolyte) during the intermission. It may also be observed, by the way, that the "enlarged" continuation curves do not coincide with the smaller ones.

The charge curve (Faure cell) cannot lay claim to being illustrative of normal conditions, owing to the abnormal discharge (continuation) immediately preceding the charge and which, of course, must have left its impress upon the plates, producing a corresponding influence upon the observations following. The electrolyte, too, differs here again, rising above its original specific gravity owing to the acid absorbed from the "fresh" electrolyte in which the discharge "continuation" had been effected. In fact this gain in the electrolyte invites a comparison with the output of the continuation discharge. It should be approximately proportionate thereto, but it is not. Allowing equal formation of $PbSO_4$ for positive and negative plates per ampere-hour of discharge, the amount of acid absorbed corresponds to one-half of 11 + 108 ampere-hours (the respective extra discharge credited to the positive and negative plates), namely, 59.5 ampere-hours. The gain shown by the specific gravity curve, however, corresponds to 87 ampere-hours if the acid temperature had remained constant, but, as the temperature rose during the charge (temperature readings are omitted, only a rise of 8° F. for a certain period being quoted), and even if this had been all the rise occurring between the beginning of the discharge and the end of the charge, the gain in specific gravity would be equivalent to over 100 ampere-hours. The assumption that this difference between 59.5 and over 100 ampere-hours is due to a greater ratio of $PbSO_4$ formation during the accounted-for extra discharge is not admissible, and the shape of the specific gravity curve of the discharge, as far as it goes (for the extra discharge no specific gravity curve is given), would not in the least support it. Nor would it seem reasonable to suppose that the "fresh" electrolyte was so excessively strong that the portion of it that may have been conveyed by the plates made such a difference. So that this reminds us again of the queer behavior credited to the negative plate on the continuation discharge. Altogether, the curve tables seem but an imperfect basis for the conclusions built thereon in the context.

In regard to standards for taking the individual plate potential differences, it would seem beyond question that the use of a single standard, which is either electro-positive or electro-negative to both plates under test, would yield curves that bear a definite relation to each other, irrespective of any possible changes in its own potential. It would also facilitate the checking off of observations in as far as the distances between the two (potential difference positive and potential difference negative) curves obtained must correspond to the independently measurable values of potential difference of the cell; and similarly with the respective electromotive force values. Dr. Streintz of Gratz, Austria, in his extensive storage battery investigations (*Zeitschrift fuer Elektrotechnik*, Vienna, Vols. IX. and XI.), has used zinc as a standard in observing the potentials of individual plates during discharge, and his results indicate that under proper conditions that metal is very satisfactory. This being the case, it is manifest that it will also lend itself to a variety of other lines of observations upon lead accumulators, including relative capacity tests of individual plates—even to observations upon a complete reversal and its concomitant characteristics—yet leaving a fair working margin between itself and the plates throughout all phases. And what is of no small advantage, the zinc standard affords a striking graphical illustration of the characteristics observed.

In testing the relative capacity of the plates, it is only necessary to discharge the cell in series with a larger cell (or two in an extreme case), in order to assist in overcoming the external resistance (wires, connections, ammeter, etc.) when




SOME STORAGE BATTERY PHENOMENA.

nearing zero potential difference of the cell, as in the case of an ordinary zero test under a constant current, and beyond that point when the weaker plate or section, owing to its sluggish action, sets up a counter potential difference in the cell. The entire test can be made without removing the plates or electrolyte, or in any way interrupting the discharge or interfering with the proper conditions of continuation, and consequently without mutilation of the curves which are to tell the tale of the characteristics sought.

The accompanying cut furnishes an example of the general shape of curves obtained by this method to and beyond the point of the cell potential difference zero. The upper curve indicates the potential difference values of the positive plate ($Zn—PbO_2$) and the lower curve those of the negative ($Zn—Pb$), zinc being the zero or base line common to both. The two curves approach each other as the discharge proceeds, finally cross as at G and deviate, if the discharge is forced toward reversal. Now, if a practical working limit of cell potential difference is prescribed or chosen (which should be well inside of the steep curvature of the weaker plate), let special note be taken of the $Zn—PbO_2$ value $a$, and the $Zn—Pb$ value $b$, on passing that limit, because here really begins the comparison of the relative plate capacities. Then, if the positive and negative plates have the same capacity, zero cell potential difference (crossing of curves) will occur at a point, $E$, corresponding to $(a+b)$, whereas, if either plate has an excess of capacity, the intersection will occur above or below that point; in the example given, the cell zero potential difference occurs at $G$. Thence the discharge is forced along until the potential difference of the stronger plate reaches the value $(a+b)$, indicated by the letter $H$. The difference between the relative capacities is expressed by the linear dimension $E—H$. Upon reducing the capacity of the stronger plate accordingly, the new curve would more or less alter its shape at the assumed cell potential difference limit, and the latter for the same value would come somewhat farther inside, as suggested by the dotted lines. The curves for charge discharge and complete reversal obtained by this method will prove instructive in various ways, and their differences may suggest further investigation into structural and other features.

The drop in temperature of a discharging cell, alluded to by Mr. Griscom, is a result dependent upon very low internal resistance and moderate current. Under opposite conditions the opposite result, namely, a rise in temperature, will occur. Mr. Griscom's explanation of the cooling effect may help to explain the heating effect also. There are two opposing functions in discharging a storage battery, which do not bear a fixed relation to each other; the chemical (or cooling) effect being proportional to the current (as is also the absorption of sulphuric acid referred to by Mr. Griscom), whereas the heating effect varies as $C_2 R$. Thus, while the cooling effect may predominate under favorable conditions, upon increasing C a point will be reached where the two factors balance and beyond which heat will ensue. This balance point, of course, varies with different types and sizes of storage batteries. In Prof. Ayrton's temperature tests, alluded to by Mr. Griscom, the cell temperature, though remaining above that of the surrounding air, fell slightly below that of an idle cell, wherein the heating was due to some local action (possibly the same two functions, with their relative magnitude reversed). Dr. Duncan and Mr. Weigand[1] mention having observed a temperature reduction in some cases, and a rise in a number of others, the data on which indicate favorable conditions in the latter direction. My own observations were also of both kinds, and numerous; especially have I noted a marked rise when discharging at such an excessive rate as to produce lively gassing at the plates, which was accompanied by a marked increase in the internal resistance. Again, in cases where a number of cells were confined within a close space affording little or no ventilation (as in an electric launch, etc.) even a slight initial rise would have a cumulative effect to a noticeable extent. These observations were made on cells in good condition.

The authors refers to "a very curious misapprehension" prevailing "among some battery people" to the effect that the negative plate exceeded the capacity of the positive, and then proceeds to prove the contrary by reference to tests, the shortcomings of which have here been pointed out. As a matter of fact both conclusions are unwarrantably broad. In view of the diverse types that are on the market, it must be observed that the relative capacity of the plates is as the manufacturer chooses to make it. It depends upon structural features, upon the relative size and thickness of the plates, the relative proportion of "active material" contained therein, and the quality, condition and distribution of the latter, each of which factors, if varied itself, will produce different results. In some accumulators the positive and negative plates are made exactly alike up to the point of final "formation," and in most of these, when in good working order, the negative plates have a considerable excess in capacity, owing, no doubt, to the spongy lead being capable of more thoroughly undergoing the chemical change than the peroxide. Dr. Frankland (Royal Society, 1890) remarked that "only half as much material seems to be necessary for the negatives as for the positive plates." Messrs. Gladstone and Tribe made similar observations. Prof. Ayrton[2] suggests an explanation why in the E. P. S. (pasted grid) type "it is necessary to employ nearly twice as much lead peroxide as is actually needed for the chemical action." Some manufacturers as much as ten years ago recognized the difference, and accordingly made the positive plates thicker than the negatives, and, although Mr. Griscom doubts the propriety of so doing, his company also follows that practice. I have myself made careful tests of the comparative capacities of plates and materials, extending over some years, and found a considerable difference in the oxides of different makers, their capacities ranging (with grid plates 1-4 inch thick), under like conditions, from 1.4 to 2.5 ampere hours per ounce of red lead in positive plates and (with similar grids) from 2.75 to 3.25 ampere-hours per ounce of litharge contained in negative plates, in all these cases putting double their amount of active material opposite them, to insure maximum output of the samples with the usual working potential difference limit, at a uniform current. Among a variety of tests to determine the relative capacity of plates working together, I have made a series of experiments calculated to yield the most direct results for practical purposes, as follows: I prepared three cells, each containing 4 negatives and 3 positives; size $7\frac{3}{4}$ by $9\frac{3}{4}$ inches; thickness, all positives $\frac{1}{4}$ inch; negatives, in one cell $\frac{1}{4}$ inch, second cell $\frac{3}{16}$ inch, third cell $\frac{1}{8}$ inch; $\frac{1}{4}$ inch grids being planed down to the respective thicknesses for the second and third cell. The oxides used were of the best quality available (the litharge being especially manufactured for storage battery purposes). The cells were worked daily for several weeks, under normal conditions, and the net results, briefly stated, were, that the cell in which the negatives were reduced to one-half their thickness and the amount of litharge therein to 38 per cent. of that contained in the $\frac{1}{4}$ inch negatives yielded an output only 16 per cent. less than cell 1. (The reason for only 38 per cent. and not 50 per cent. of litharge being in the $\frac{1}{8}$ inch plates was in the perforations being tapered.) The object of this experiment was to find how thin a negative would answer for a given positive with the materials used, without undue sacrifice in the capacity of the cell, and the results obtained approximately correspond with theoretical deductions. General speaking, the results do not vary exactly with thickness, volume and weight, but many other minor points, as above indicated, necessarily contribute in determining them; the subject is too intricate to be broadly covered by either Mr. Griscom's implied conclusions or the one he undertook to refute.

I concur with Mr. Griscom in his views on the success of storage batteries in Europe, and their lack of success in this country. Other points of comparison suggest themselves, among which are the generally greater day load of central stations in this country, due largely to a more general use of motors, which tends to make the use of storage batteries a somewhat less pressing object, and further, the entire absence, until recently, of large, substantial and durable types of cells suited for central station purposes. While in Europe central station types have been given the utmost attention by manufacturers, with corresponding success, American storage battery manufacturers, on the other hand, have largely endeavored to cope with that alluring subject, storage battery traction—unfortunately with but little success—and neglected to cater to the central station field with types especially adapted to that class of work.

MR. GRISCOM: Some of the points made by Mr. Reckenzaun show that my paper requires a little further elucidation:

First—Mr. Reckenzaun says that the text is rather remarkable for its omissions with respect to the curves. I did not pretend to give a complete analysis of the curves, which,

1. *Transactions*, vol. vi., p. 2 7.
2. Inst Elec. Eng., London, 1890.

by the way, are perfectly normal, but only to use some features of them to illustrate my paper.

Second—He states that I adopted two separate standards, one for each plate under test, and states that owing to the inconstancy of the standard cell (test cell), the potential difference curves for the separate plates actually represent the resultant values of two unknown and varying factors. The total discharge of the "test cell" during the 300 or 400 readings represented by the curve did not exceed $\frac{1}{2000}$ part of its capacity. Therefore, there was no change appreciable to my instrumeots in the electromotive force due to the amount of discharge. Similarly, the current was about $\frac{1}{2000}$ of the ordinary discharge rate of the plate; consequently there was no appreciable modifications in the readings due to the discharge rate. The total variation of the "test cell" in discharge is, as shown by the curve, about $\frac{1}{10}$ of the total variation of the cell under test, say .03 volt, of which about .01 volt was due to the negative and .02 volt to the positive. And this variation, which Mr. Reckenzaun is pleased to call "inconstancy," is due entirely to the specific gravity and temperature of the electrolyte. The advantage of using this plan is evident. Inasmuch as the temperature and density of the electrolyte affect the "test cell" and the cell under test equally, and inasmuch as the "test cell" and the cell under test are of the same nature, this plan enables us to eliminate the effect of the change of temperature and of average density from those curious changes going on in the plates which it was my endeavor to lay before the Institute.

Third—Later on in Mr. Reckenzaun's communication he appears to recommend the use of a single standard and refers to the investigations of Dr. Streintz of Gratz, Austria, who used zinc. I have also used zinc in past years, but abandoned it on account of its solubility in the electrolyte, its tendency to deposit during charge on the negative plate and the false effects due thereto, and for other reasons. It is true that by using separate cells and by taking precautions to prevent the intermingling of the electrolytes, it is not impossible to obtain important results with the use of a single standard, but unfortunately it is necessary to make an exhaustive and complete research into the various behaviors of the single standard in the presence of a varying electrolyte and a varying storage battery plate, before it is possible to be sure that curves with any single standard represent anything but the misleading resultants of unknown and varying factors. On the other hand, by using for the test cell well-charged storage battery plates, which have been allowed to stand until they have reached a stationary electromotive force, you obtain fixed and invariable and scientific results because you obtain the loss of potential, which is due purely and simply to the plate under test. It is as though you measured the difference of potential due to the changes in that one plate while the opposing plate had undergone no change from the beginning. The use of single standards will not do this. They give simply a comparison which is not only uncertain in its nature, as explained above, but which has no relation to the real use of storage batteries.

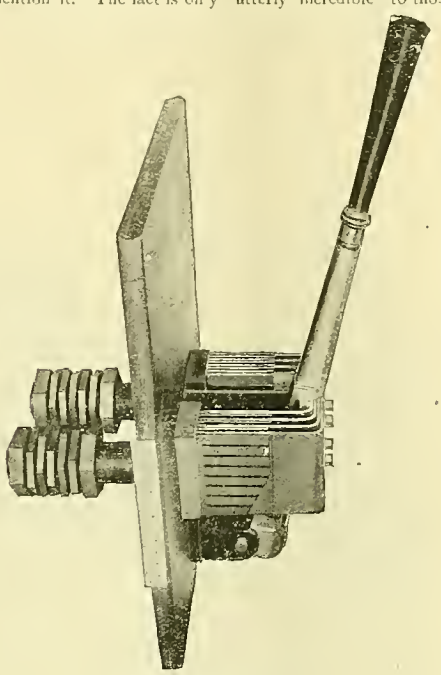
Fourth—It does not appear whether Mr. Reckenzaun or Dr. Streintz is responsible for the method which he advises for testing the relative capacities of the plates of a storage battery. The idea of forcing a current for this purpose through a battery which has ceased to be active whether through the exhaustion of one or both of the plates, is, to say the least, open to criticism. If the negative plate, for instance, becomes exhausted first, as usually happens, forcing a charge through it means charging it in the reverse direction, so that you have the anomaly of a negative plate charged, or still worse, partially charged, as a positive opposed to a positive in the same cell. The experiment, of course, is interesting; in fact, I have no doubt that this very thing frequently occurred in former practice, in the dark ages of storage batteries, when cells frequently got exhausted by short-circuits and buckling, were straightened and cleaned again, and put in service only half charged. Buckling and short circuiting are happily things of the past, but Mr. Reckenzaun's method would yield an interesting study of the behavior of a battery when treated in the best manner to ensure its destruction.

Fifth—Mr. Reckenzaun says in reference to the continuation of the discharge of a Faure cell, that, "if the compensation above referred to were made," the curve would undoubtedly be nearer the horizontal than shown. I think there is no reason for this conclusion of Mr. Reckenzaun. The continuation of the discharge was made with fresh plates of the L type, the capacity of which was many times in excess of the remaining capacity of the cells under tests—so much so, in fact, that there was no appreciable falling off in potential on the part of the larger plates, and the curve of the test cell was therefore omitted as superfluous.

Sixth—The fall of temperature on discharge is a difficult thing to explain. Unfortunately for Mr. Reckenzaun's explanation, the cell will sometimes indicate a rise of temperature and sometimes a fall under what appear to be, externally, at least, exactly the same conditions. I am not inclined to believe that such an eminent scientist as Prof. Ayrton could have made an error due to local action in an idle cell, as Mr. Reckenzaun insinuates. And in this connection, as against his theory that there is a marked rise of temperature whenever there is "a marked increase in the internal resistance," I will remind him of the tests which were made under his supervision in our Newark laboratory in 1887. In one of these tests the cell was discharged at the rate of 40 amperes to 1.8 volts. The records show that the temperature of the cell fell .9° F., and at the time when the cell reached 1.8 volts, its temperature was actually .4° below that of the air, and yet, as everyone knows, the internal resistance of the cell under those circumstances was at least double its average internal resistance, and the current remained constant at 40 amperes. This seems to be in direct contradiction of Mr. Reckenzaun's theory. To be sure, such a test, crudely made in a factory laboratory, has not the weight of a test made by Prof. Ayrton, assisted by competent electricians and checked by all the skill and resources of a trained scientist for the express purpose of instructing the scientific world. But when the test conforms to Prof. Ayrton's results, it seems entitled to at least as much weight as some other crude tests which differ from these results. In Prof. Ayrton's experiment he found that the heat produced by $C_2 R$ amounted to 3,456 calories, whereas the heat loss due to the cell cooling down amounted in some cases to 12,000 calories—three or four times as much. Furthermore, the heating due to $C_2 R$ in a given cell does not vary directly as the square of the current, because the internal resistance diminishes as the current increases, and what is still more curious, the electromotive force itself appears to increase. Mr. Reckenzaun talks of experiments in which an excessive disch rge rate increases the I R. He must have beeen using cells of extremely faulty design, or else he must have made his measurements after the cell had exceeded its proper working capacity for the discharge rate, or else he based his statement on guesswork instead of experiment. I have never known of such a case.

Seventh—Mr. Reckenzaun devotes some space to what he calls the "queer behavior" of the negative plate in the continuation of the discharge of the Faure curve, and proves that it is "queer" by an argument based upon certain apparent behaviors of the electrolytes as shown by the curves. The facts are not as Mr. Reckenzaun assumes. The relative proportions of electrolyte were not the same in the charge and discharge, and there is consequently no relation between the actual measurements of the specific gravities in charge and discharge. The specific gravity curves are absolutely independent of one another, and if used for purposes outside of my paper should be studied independently.

The "queer behavior" which so impressed him is what always takes place in the complete discharge of a negative plate of good construction, and the fact that some electricians did not know of this "queer behavior" was perhaps a sufficient reason for me to mention it. The fact is only "utterly incredible" to those



LARGE AJAX SWITCH.

who are too credulous of outworn theories, and who will not venture to subject them to actual test.

His explanations, that there might have been short-circuits, or unsuitable electrolyte, or undue exposure of the negative to air, display a singular idea of scientific tests. It may be proper to inform him that such infinite precautions hedge about laboratory work of this nature that none of these things could occur. Moreover, the negative, even if exposed to air, does not lose any capacity whatever until it begins to heat; and after it has heated, it does not recuperate to two volts, or more, but behaves like an entirely different material with a much lower electromotive force. I think all the voltage readings are correct within two-tenths of one per cent.; any possible errors in any of the curves are in one direction, so that what I particularly desire to set forth, to-wit, the relation between the curves, is accurately shown.

Eighth—Mr. Reckenzaun takes it very hard that I should have said that a very curious misapprehension prevailed among some battery people to the effect that the negative plate exceeded the capacity of the positive, and he then points out alleged shortcomings of the curve upon which he appears to think I based my statement. Of course I did not rely on any one experiment, but upon many hundreds of tests. If Mr. Reckenzaun wants to attack them by repeating the tests under the same conditions, I shall, of course, have no objection, but I must protest against having my curves demolished by faulty dialectics based on errors of fact. I am surprised that Mr. Reckenzaun should not have known that the negative plate in all usual and commercial storage batteries of good design has less capacity than the positive, and that the curve at the end of discharge for both plates is for a considerable space a nearly vertical line—the loss of a volt in five or ten minutes being of usual occurrence. His method of testing the relative capacities of the plates is roundabout, and the results have evidently misled him. The simplest ways are the best. My usual method is to place one plate between two others of several times its capacity and discharge it to exhaustion. In this way its curve is purely its own curve, practically unaffected by anything but the electrolyte, and the insignificant loss of potential of the larger plates. Care is taken to maintain the electrolyte at the proper density. A similar curve is made of the other plate and any changes of proportions which may be desirable are calculated from the curves.

Ninth—The citation which Mr. Reckenzaun attributes to Dr. Frankland in support of what appears to be his theory, to-wit, "only half as much material seems to be necessary for the negative as for the positive plate," was made by an anonymous writer in the *Electrical Review*, of London, of August 22, 1890, in an article referring to Dr. Frankland and not by Dr. Frankland himself. It would not be astonishing, however, if Dr. Frankland had assumed this to be true, as did many other scientific gentlemen at that time; but experiments of Crompton, Anthony Reckenzaun, Drake and Gorham, which I have confirmed myself, show that it is not true. The original idea obtained currency, I believe, because in the original formation of a battery it took twice as much energy to form a given weight of negative element as it did of positive element, and it was then supposed that on discharge after formation, the chemical processes were reversed; but such is not the fact.

Tenth—His reference to the *Journal of the Institution of Electrical Engineers*, 1890-1891, containing Prof. Ayrton's papers, is fortunate, for it contains a refutation of the very theories which he is endeavoring to support by it. In the discussion following one of Prof. Ayrton's papers, Mr. Reckenzaun's brother gave a clear and logical explanation of the causes which made it difficult, if not impossible, to furnish a durable negative plate with more capacity than the positive, and told why the positive plate in the E. P. S. form of battery always showed, after the cell was discharged, the presence of a large amount of lead peroxide. The reason he gives for the latter effect is that the negative plates become exhausted too soon, in other words had too little capacity, and so left the positive plates only partially exhausted and consequently with a large excess of peroxide. This explanation, I think, is at least partially true, inasmuch as the negative plate in the principal batteries of the world, when new and in good condition, always becomes exhausted first. I ought, perhaps, to add that I referred to commercial batteries of usual types and in good condition, and not to the abnormal types which occasionally make their appearance in the market with excessively large pellets of active material, the centers of which gradually grow inactive. In this connection, I am sorry that Mr. Reckenzaun was not more specific in alleging an error in the "enlarged" continuation curves. I fail to find it. Both curves were made directly from the notes of the tests.

Eleventh—The experiments which Mr. Reckenzaun performed for us and which he relates in his paper, viz., the ones where he reduced the thickness of the negative plates and obtained 84 per cent. output with 38 per cent. of negative active material, are also explained by Mr. Reckenzaun's brother in the discussion before the Institution of Electrical Engineers three or four years ago; in a word, a greater proportion of the spongy lead was active in the thin plate than in the thick plate.

Twelfth—Mr. Reckenzaun's curve, which he says has the "general shape of curves obtained by" his "method," reached me after writing the foregoing. I am at a loss to tell, from his cautious language, whether the curve was purely hypothetical, or whether it was the result of the actual measurements of a roundabout method. In either case, it suits his argument in appearance, and is an admirable proof of the danger of using any but direct methods of ascertaining scientific facts. There is only one safe way of ascertaining the relative capacities of positive and negative plates, and that is by measuring them independently. Any other way until checked by a direct method may involve misleading and unknown factors. Mr. Reckenzaun's curve (with zinc standard) shows an easy slope for one-fifth of the total discharge to zero on the part of the negative, and for one-third on the part of the positive. Such a thing never occurred in a normal storage battery discharge. During the latter part of complete discharge the electromotive force of each plate is always on a mad rush to perdition—measured not in hours, but minutes or seconds. His curve is not representative of the behavior of a well designed cell in normal discharge, nor even of the worst commercial cell which has ever come under my notice. Nevertheless, the curve is of a novel nature, and if not purely hypothetical may open the field in curious and unexplored directions

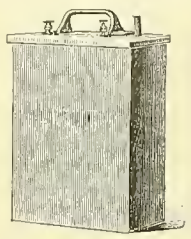
## Large Ajax Switch.

With the growth of electric traction and the consolidation of street railway interests, there has been a gradual tendency toward larger power stations with larger generating units, and, consequently, proportionately larger station apparatus. Until recently, a switch which was guaranteed to successfully rupture a circuit carrying 3,000 amperes of current, at a potential of 500 volts, was considered a giant in breaking capacity; and the Ajax switch demonstrated the utility of such large quick break switches, and the ability to open a circuit carrying 2,000 horse power of electrical energy at 5,000 volts potential, without the slightest injury to either the operator or the apparatus. During the interim Ajax switches have been designed for 4,500 amperes, and several such are in actual service on street railway circuits.

In the accompanying cut is illustrated another advance in switches, a new "plunger" type Ajax switch of 7,000 amperes capacity. This switch is guaranteed to break its full rated capacity of 500 volts potential, or nearly 4,700 horse power. It was ordered by the Electric Traction company of Philadelphia, through the General Electric company, which is building the switchboard for the new Delaware avenue power house. Except the carrier and stand, which do not form any part of the circuit, the entire switch is made of commercially pure copper, and provision is made for clamping directly to a laminated bus bar, consisting of six bars, each 5 by ¼ inches or a total of 7½ inches sectional area, which is also the minimum of sectional area in any part of the switch.

The contact area, finish and action are of the well-known Ajax formula. The switch is compact in form and occupies

a space only 14 by 13 inches on the switchboard. A handle of unusual length is required to operate these large and close fitting blades, which overhang the switch proper several inches. The total length of the handle from the pivot is 41½ inches, and terminates in a highly polished piece of old mahogany. As a continuous current circuit breaker, it is believed that this switch is the largest yet attempted.



LIGHT WEIGHT STORAGE BATTERY.

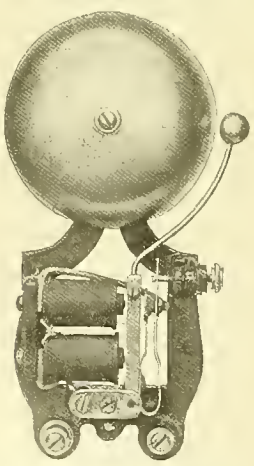
The Ajax switch is manufactured by C. S. Van Nois, 136 Liberty street, New York.

## Light Weight Storage Battery.

A new storage battery illustrated in the accompanying cut, and for which excellent claims are made, has just been placed on the market by Haschke & Creelman, 20 to 28 West Randolph street, Chicago. The battery is very light in weight, small in size, and is capable of withstanding rough handling. It is claimed for this battery that the weight is reduced without impairing the efficiency. The elements in the 300 ampere hour cell, especially constructed for street car propulsion, weigh only 34 pounds. The cell is five inches wide, seven inches long and ten inches high. One of the main features of the battery is the secret process of insulation used in separating the elements. This insulation is electro-chemically treated, and when placed between the elements, causes them to solidify and withstand punctures or rough handling, and renders buckling, it is said, practically impossible. The batteries have a very low internal resistance. The chemical action is very quickly revived after an excessive discharge, thereby maintaining a constant voltage.

## Varley Bug-proof Bell.

The race of bugs which, according to nursery rhyme, was supposed to be happily domiciled in some convenient rug, or rugs, has apparently died out or else unanimously cancelled their lease on rug properties and moved to mansions higher up on the wall. Any bell hanger who has jabbed bugs out of a bell and chased them out of annunciator cases will readily concur in the supposed exodus. Of late years it has been the constant effort with manufacturers to construct a style of bell that would effectually bar these unwelcome tenants. But the bugs have remained around the cheerful blaze of the contact points just the same. In the Varney bell, which is shown in the accompanying illustration, this single vulnerable point has been ingeniously protected by a small elastic covering that completely encloses the solid platinum contacts, but does not in the least restrict the free vibration of the clapper. The bell being otherwise of the open frame construction, there are no inviting nooks where



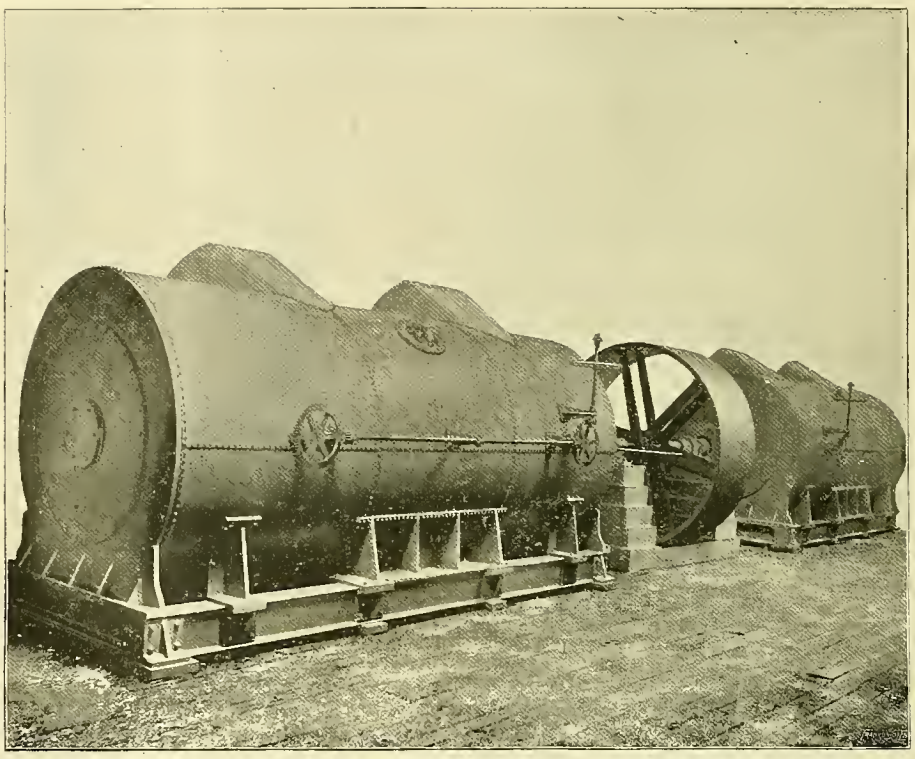
VARLEY BUG-PROOF BELL.

bugs will gather. The magnets are duplex wound and so arranged that the armature gets the full benefit of the pull and can be operated with much less battery than needed with an ordinary bell. All adjustment screws have locknuts so that they cannot work loose. It seems an admirably constructed bell in every way. The Central Electric company, 173-175 Adams street, Chicago, is making it one of its specialties and reports a very satisfactory demand from dealers who buy the better grades of electrical merchandise.

## Woonsocket Electric Company's New Water Power Plant.

The accompanying illustration shows the powerful water wheels which have recently been installed in the new station of the Woonsocket Electric company. The old bulkhead gates and the attendant racks, etc., which originally belonged to the property have disappeared, and in their place are substantial hard pine framing and modern gates five and one-half inches in thickness, raised and lowered by an ingenious leverage arrangement requiring but little outlay of strength in the operation. The feeder tubes to the wheels are circular in form and come through the solid frame and plank to the gates themselves. From here the water passes through the feeder tubes to the power plant, which consists of two pairs of 36 inch cylinder gate Victor turbines, on a horizontal shaft, operating under 17 feet working head and developing 600 horse power.

Each pair of turbines is mounted in a separate wrought-iron flume, which rests on double steel I beams, which are suppported at either end by the wheel pit walls. The water is conveyed to these flumes, from the forebay outside of the building, by means of two wrought-iron feeder pipes



WOONSOCKET ELECTRIC COMPANY'S NEW WATER POWER PLANT.

which enter the flume nearly over each turbine. Each feeder pipe is supplied with a head-gate, by which the water can be entirely shut out of the flumes in case it is found necessary to enter for examination or repairs. The flumes are also supplied with a cover at each end, which can be removed, leaving an opening large enough to remove any part of the turbine if it is ever found necessary to do so from accident or other cause.

Each pair of turbines has a governor for regulating the speed. These governors and the hand-wheels for operating the gates are located on the floor above the wheel room. Midway between the two flumes is the main driving pulley, which is 11 feet in diameter, with width of face sufficient for a belt 48 inches wide. The speed of the turbine shaft is 133 revolutions per minute, and with a pulley of this diameter, a belt speed of 4,595 feet per minute is obtained. This pulley is keyed to a steel shaft 7⅜ inches in diameter, which runs in the latest pattern self-oiling swivel boxes. Connecting each end of the shaft which carries the large driving pulley with the shaft from each pair of turbines is a Worrell friction clutch coupling, so that the pulley may be driven with either or both pair of turbines. Throughout the entire power plant simplicity and strength are prominent features, and much credit is due the builders, the Stilwell-Bierce & Smith-Vaile company of Dayton, O.

On the floor above the wheels, running parallel with the front of the building, is a heavy line of 6 inch shafting with a receiving pulley with 51½ inches face and 64 inches in diameter connected with the wheel shaft by a three-ply belt 50 inches in width. To the left of the receiving pulley are three driving pulleys, each 69 inches in diameter and 15½ inches face, each operated by a Worrell or Laconia friction clutch. These pulleys are for driving the power generators, which are connected by 15 inch three-ply belts. These generators are installed on massive brick and stone foundations reaching to solid ground ten feet below the water line. To the right of the receiving pulley is another pulley 69 inches in diameter with a 15 inch face, operated, as are the others, by a Laconia clutch, which will be used to transmit power to the rooms above as they may be leased for manufacturing purposes.

## The Knapp Failure.

The association of creditors of the Knapp Electrical Works, through its executive committee, has employed F. E. Bard, an expert auditor, to go over the books of the concern and make a report.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, September 24.—The Court of Special Sessions at Newark, N. J., has declared Michael Lewis, a trolley car motorman, guilty of manslaughter. Lewis was the motorman of the South Orange car which killed a little girl in August last at Newark, and the case has excited much interest. Testimony as brought out by the trial showed that the motorman was looking toward the rear of the car when the accident happened, that he did not have hold of the brake and that no warning was given. Lewis, however, swore that the little girl ran in front of the car, that he was ringing the gong at the time and that he had his car under control. Lewis will be sentenced to-day, and it will be the first case of its kind so decided in the Essex county courts. The full penalty for manslaughter is ten years in the state prison. The case was tried before Judges Kirkpatrick, Ledwith and Shalk.

By a resolution of the Board of Aldermen, passed last Tuesday, the Metropolitan Traction company was authorized to construct a most important connecting link in the system of roads which is to afford transit by electricity and cable from the upper end of Harlem down both sides of Central Park to the lower end of the city. The link will connect the present Columbus avenue line and the projected cross-town line at One Hundred and Sixteenth street, which is fed by the road now under construction in Lenox avenue. If the expectations of the company are fulfilled, six months will see electric cars on the subway trolley system running on both the latter thoroughfares and connecting on the west and east respectively with the cable roads in Columbus and Lexington avenues. The passage of the resolution leaves the way clear not only for through traffic, but also for the introduction on the upper end of the system of electric traction instead of the cumbersome cable. Second Vice-president H. C. Robinson of the Metropolitan Traction company says that the company will now go ahead with the installation of an electric line down Lenox avenue, running east and west on One Hundred and Sixteenth street and down Lexington and Columbus avenues

to Ninety-eighth street, and if it is proved successful it is only a question of time when it would supplant the cable throughout the whole system. The company has long been desirous of securing a thoroughly practicable system of traction by electric wires which could be laid in the existing cable ducts, and several of the engineers were sent abroad last spring to study the system now in use in Budapest. They reported favorably, and as I announced in this correspondence at the time, a contract was recently entered into with the General Electric company for the construction of four miles of road which, at the option of the traction company, may, after successful trial, be extended to eight miles. A site for a power house has been secured at One Hundred and Forty-fifth street and Lenox avenue, on which a force is already at work laying down the tracks.

The question of rapid transit in New York city is in the hands of the people and will be practically decided at the approaching election, when the advisability of constructing the proposed road at the expense of the city will be voted upon. The laws of 1894 provide that within 30 days of the election the members of the Rapid Transit Commission shall file with the officials having charge of the printing of official ballots—in this city the police commissioners—a request that ballots be printed for and against the proposition that the city shall build the road.

A curious case of death by the electric current attracted much attention here last week. A boy touched an iron railing to a flight of steps and was so badly shocked that he died in a few moments. Two men who attempted to rescue the lad were also severely shocked. The steps at No. 203 Chrystie street, where the accident happened, lead up to the high stoop of the double tenement house at that number. In the basement is a barroom and restaurant, and two wires run from a pole standing in front of the building to a transformer which rests on a tin cornice over the basement and under the first floor windows of the tenement house. The box is concealed from sight by the sign, which also rests on the cornice. The end of the cornice touches both hand-rails of the stoop, which is directly in the center of the building. From the transformer the wires extend to an electrical meter just inside the restaurant door and to the fans. The wires inside the restaurant are concealed and are insulated. Evidently the insulation of the wires had become worn through and a short-circuit was made, the full pressure of the primary wires passing from the transformer and along the sign, which made contact with the railing. Slight shocks had previously been noticed by those who ascended the steps and touched the railing for support, which may be easily accounted for. The transformer box was set on fire by the current and, it is reported, was extinguished by a bucketful of water poured upon it. If the foregoing explanation of the accident is correct, it would not have been surprising if a second victim had been added to the list, a liberal supply of water not being recognized by the best authorities as the proper means of treating a short-circuit on a primary main of a high tension alternating system. W. F. O.

## PERSONAL.

H. H. Cutler of the Cutler-Hammer Manufacturing company has returned to Chicago after an extensive trip through the East.

Herbert Lloyd, general manager of the Electric Storage Battery company, Philadelphia, was in Chicago several days last week upon business for his company.

W. C. McKinlock, secretary of the Metropolitan Electric company, Chicago, is out of the city on important business connected with his company.

Edward L. Barr, recently agent of the General Electric company in Canada, will in future represent the Wallace Electric company of Chicago. Mr. Barr is well known to the electrical trade and has had a large experience in the business.

Dr. F. P. Vandenbergh of the Vandenbergh Laboratory of Buffalo, N. Y., was in Chicago last Tuesday. Dr. Vandenbergh has been retained as consulting chemist by interests in Peoria, Ill., his present destination.

Samuel W. Rushmore, the well-known electrical engineer and manufacturer of Jersey City, N. J., paid a flying visit last week to Chicago. Mr. Rushmore states that he found business in his line particularly good in the West, and that he made several good deals while in this territory.

Treasurer George J. Jackson, of the Norwich Insulated Wire company, New York, has been spending a few days in Chicago. The business of the Norwich company in the West is now under the management of G. L. Wilmerding. Mr. Wilmerding is getting his share of the business, and reports that the outlook for a good trade is most encouraging.

## NEW INCORPORATIONS.

Petersen Electric Conduit Railway Construction company, Milwaukee, Wis.; capital stock, $500,000; Albert E. Smith, Milwaukee, Wis.

## ELECTRIC LIGHTING.

The Potomac Electric Light company's property in both the District of Columbia and Virginia, comprising the power house and all machinery therein, together with the poles, wires and franchise in the District and Virginia, was sold at public auction recently. The price brought was $17,500. The purchaser was Mr. Wilder of Minnesota, who had advanced the money on the company's bonds. He was represented at the sale by A. H. Walkins of St. Paul. The amount advanced by Mr. Wilder is said to have been $25,000. The face value of the bonds taken as security was $50,000.

The city commissioners of Youngstown, O., have contracted for street lighting with the Mahoning Electric Light company for a period of seven years, and at the rate of $64 per arc light per year, Philadelphia schedule to govern, with 2,400 extra hours gratuitous if needed. The present contract of $67.50 per light has two years yet to run, but by terms secured by the commissioners the new contract abrogates the old one and is for seven years. The city now has some 230 arc lights and 400 vapor lights. It is proposed to add 60 or 65 more arc lights and this will do away with the vapor lights entirely.

Edwards Falls, above Manlius, N. Y., has been bought by a company represented by Edward Kanaley of Eastwood Heights, and contracts have been made for lighting by electricity the villages of Manlius and East Syracuse. The company was refused permission last week to string wires through Fayetteville, and the people of that town decided not to enter into any agreement relative to electric lights. Another meeting was held, however, and after listening to explanations by Mr. Kanaley a more favorable conclusion was reached, and the village board was instructed to grant the company the privilege of running wires through the village. A committee of five was appointed to inquire into the whole subject of electric lighting and report to another meeting in two weeks.

## ELECTRIC RAILWAYS.

A press dispatch from Cresson Springs, Pa., where the meeting of Western Union Insurance managers, representing the principal states in the country west of Pennsylvania and especially of the north central states, was held, announces that the rating of buildings where electricity is taken from trolley wires and used for power or light has been raised 1 per cent. over the minimum rate now charged.

Negotiations are pending regarding the construction of the proposed Niagara Falls and Buffalo electric railroad. George P. Smith of one of the roads from Tonawanda to Buffalo has made a proposition to President W. Caryl Ely of the proposed Buffalo road which contemplates the construction by Mr. Ely of his road to Tonawanda and then to connect with Mr. Smith's road to Buffalo under a pro rata arrangement.

The managers of the Philadelphia, Cheltenham & Jenkintown trolley road expect to have cars running regularly to Willow Grove, the northern terminus of the line, early next year. The work of constructing the road is being pushed as rapidly as possible, and ties have already been laid on York pike from Rising Sun to Logan station. The stone bridges along the route are being widened so as to accommodate the double track line.

## MISCELLANEOUS.

J. G. Davis of Altoona has been appointed receiver of the Robinson Machine company, manufacturer of electric railway supplies at Bellewood, Pa., Harry A. Gardner, the defaulting cashier of the closed Second National bank of Altoona, was the controlling power in this company, and the funds of the bank were appropriated, it is said, to float the concern.

The Minneapolis Minn., General Electric company has decided to erect a new power station of such spacious dimensions that the two stations now maintained in the Edison building and at the foot of Third avenue North will be abandoned. The new plant will entail the expenditure of $200,000, and will be located on the east bank of the river at Third avenue Southeast, on the site of the old Merriam-Barrows saw-mill and opposite the Phœnix mill. The plant, it is said, will be one of the most complete and modern in the country, and may possibly be completed ready for occupancy by January 1st.

## TRADE NEWS.

Price list No. 894, recently issued by the Butler Manufacturing company, 46 and 48 South Clinton street, Chicago, is filled with useful applications of electrical specialties. Lamp hoods and weather protectors occupy considerable space, and a number of designs are shown.

The Eastern Electric Cable company of Boston, manufacturers of Clark wire and cables, recently purchased a large frontage of ground upon Tremont street, in addition to that it now owns and will soon build an extensive addition to its factory. The company reports that August was next to the largest month it has had in its business, and that it is crowded with orders.

The Metropolitan Electric company, 186 and 188 Fifth avenue, Chicago, reports business to be good and announces the receipt of several large orders for wire and construction material and new plants entire. The company has recently received a large consignment of special split locust pins for high-class electric light and railway work and is ready to fill orders promptly for these goods. The company's N. I. R. wire is universally called for, and sales in this line are increasing.

The Norwich Insulated Wire company, 44 Broad street, New York, has illustrated in its latest handbook the styles of cables used for the electric light and power work which it supplies, as well as telegraph, telephone, railway, submarine, police and fire alarm cables. Explanatory reading matter accompanies the illustrations, and several interesting and valuable tables are contained in the book. The Chicago office of this company is at 522 Monadnock building, and is in charge of G. L. Wilmerding.

The Mather Electric company of Manchester, Conn., reports the sale of one or its 180 kilowatt improved new type multipolar railway generators, with complete station equipment, to the Hartford & West Hartford Horse Railway company for the Hartford, Conn., power house. This generator is to replace a 200 kilowatt generator. In 36 hours after placing the order, the Mather Electric company had the road running successfully, it, in that time, having removed the old generator and installed two temporary generators.

"Historical and Descriptive Review of St. Louis: Her Enterprising Business Houses and Progressive Men," a pretentious illustrated book, devoted, as its title implies, to the subject of presenting the business interests and points of advantage claimed by St. Louis, is being presented by the American Electric Manufacturing company, which is located at 2011-2017 Pine street. The company is the manufacturer of the American incandescent lamp, and an extended notice of the company's work occupies the back cover of the book.

Grier Bros., managers of the western office of the Bryant Electric company, have issued a neat folder illustrating some of the specialties recently placed upon the market by the Bryant Electric company. Among these specialties are a 500 volt cut-out, a chandelier pull switch, an attachment plug and special receptacles for shade-holders, all of which are satisfactory and substantial articles. A complete line of these goods is kept in stock in the storeroom of the western office, in the Monadnock building, Chicago.

The Electrical Subway Commission of Baltimore has awarded the contract for the subways for the police and fire alarm telegraph wires to the White-Crosby company of Baltimore for $63,487.04. Terra cotta conduits of the "Camp class," with three-inch ducts, will be used. In making his report on the bids, Consulting Engineer Hill said: "In consideration of the excellence of the designs submitted by the White-Crosby company, which, in my judgment, were the most complete and fulfilled the requirements of the specifications more nearly than those submitted by the other bidders, I would recommend that they be awarded the contract for terra cotta conduits, 'Camp class,' at the prices submitted by them in their proposal, which would make the system as proposed cost $63,487.04."

The two September catalogues for 1894 of the Siemens & Halske Electric company of America deal with types I and L H generators and motors manufactured by the company. Type I is an internal pole machine. Beginning with the well known bi-polar type, with drum armature, this dynamo has been evolved gradually, through a long and costly course of study and experiment to the form which is now used—a huge multipolar machine, in which all the reactions are calculated with mathematical exactness, and all the parts are manufactured with the accuracy of those of a chronometer. These machines may be either belt driven or directly connected. This catalogue contains several excellent reproductions of Siemens & Halske electrical machinery as installed. Type L H is a bi-polar dynamo, and is fully described in the other catalogue. Both books contain long lists of users of these classes of apparatus.

Edward Wertheim, 207 and 209 Lake street, Chicago, manufacturer's agent for German asbestos goods, has issued a very interesting work noting many of the applications of the substance as well as a well written article descriptive of this interesting mineral. Mr. Wertheim's book contains several pages of interest to electricians. Reference is made to asbestos insulating tubes, which can be applied after the wire has been laid and serve as a protection against leakage of electricity with attendant fires. These tubes deserve particular attention, as they are a reliable safeguard for preventing fires which may occur from the use of the electric current. They are made in any length and diameter and split at the side, the two edges overlapping. Mr. Wertheim also describes asbestos paper weighing but two ounces to the square yard which is particularly suitable for electrical insulation on dynamos, etc. Asbestos gloves are reliable safeguards for linemen handling live wires and can be furnished with an inside coating of india rubber. The goods handled by Edward Wertheim are manufactured in Germany by Louis Wertheim, who has developed the possibilities of asbestos and made it into its numerous applications for the last 30 years.

## BUSINESS.

The Eddy Electric Manufacturing company of Windsor, Conn., recently sold a 200 kilowatt generator to the Hartford & West Hartford Railway company.

The Washington Electric Company, 201–207 South Canal street, Chicago, has been compelled to work overtime in order to catch up with its orders for the Washington arc lamp and other well-known specialties.

President Pliny Jewell of the Jewell Belting company of Hartford, Conn., left on Saturday last for Europe for a short business trip. The company is now doing a larger business than at any time for the last year, and reports the future as being especially bright in the electrical line.

The Scott Electric Lamp company has succeeded to the business of the Scott Electric Manufacturing company, 126 Liberty street, New York. The company will be a manufacturer of arc lamps, among the specialties being the Huntington searchlight, focusing lamps for photo-engraving, electro-calcium lights for theatrical use, multiple series and series lamps for low tension and high tension currents.

The Metropolitan Electric company calls attention to the fact that it is handling the Kester Monarch arc lamp, representing the F. P. Little Electrical Construction & Supply company, Buffalo, maker of this lamp, in the West. W. E. Parker, who has been pushing the sales of these lamps during the summer, has returned to Buffalo. A stock of these lamps is kept on hand in all styles. Shipments can be made promptly.

The Wallace Electric company, Chicago, has closed

arrangement with the Hope Electric Appliance company of Providence, R. I., to represent it in the West. The Wallace company will carry in stock a full line of cut-outs manufactured by the Hope company. These cut-outs are designed for various uses and have been approved by the Board of Underwriters of Chicago as well as in other large cities throughout the country.

The Berlin Iron Bridge company of East Berlin, Conn., has erected for the Mather Electric company a new building 300 by 30 feet, equipped with improved electrical machinery, and a 40 ton electric traveling crane, especially adapted for building large directly connected generators for railway work. The unfinished castings are brought in at one end of the shop, and are loaded on the cars at the other end as finished generators.

Frank S. DeRonde, general sales agent of the Standard Paint company of New York, is in Chicago and is arranging to reopen the Chicago office, which has been closed during the summer. J. C. Shainwald, a brother of R. L. Shamriald, will be in charge and be pleased to see the many patrons and friends of the Standard Paint company. The Metropolitan Electric company will still act as general agent for the widely known electrical material manufactured by this company.

The Electric Appliance company, Chicago, is experiencing a brisk run on its Packard transformer, which is making a great reputation for its close regulation on light and full loads. It is also claimed that by a peculiar method of winding an insulation is secured which precludes all possibility of a burnout. One of the exhibition tests which the Electric Appliance company claims can be made on any of the Packard transformers successfully is to run it under a heavy overload with the case filled with water, without in any way affecting the operation of the converter.

The syndicate of electric roads known as the Union railroad of Providence, covering the cities of Providence and Pawtucket and the surrounding towns of Coventry, Cranston, Cumberland, East Providence, Johnston, Lincoln, North Providence and Warwick, operating over 120 miles of road, some time ago determined to heat its cars by electricity. After careful investigation the Union railroad decided to adopt the heater made by the Consolidated Car Heating company of Albany, N. Y. The order of the Union railroad is for 200 cars. The Consolidated company is also at the present time equipping six other important roads.

Warren & Lozier is the name of the mechanical and electrical engineering firm which has succeeded the New York Electrical Repair company. The new firm is located at 465 Greenwich street, New York, and is prepared to design and repair mechanical and electrical apparatus in general. Dynamo and motor supplies will be kept in stock and machinery of a special nature will be manufactured. Aldred K. Warren, after taking the mechanical engineering course at Kings College, London, divided 11 years of practical experience in mechanical and electrical engineering between the Canadian Pacific Railroad company's shops, the Worthington Hydraulic Works, a six months' visit to the larger factories abroad, and the balance of the time in the various engineering departments of the Edison and General Electric companies at Schenectady, New York, and Peterboro, Ont. He resigned the superintendency of the New York repair shops of the latter company to organize the New York Electrical Repair company, in which until lately he has been associated. Robert T. Lozier, the other member of the firm, started with the Edison Electric Light company in 1883, was with Mr. Edison in his construction department, and was later associated with Mr. Kennelly at the former's laboratory, being in charge of the testing department of the Edison Machine Works. He was connected with F. J. Sprague at his experimental shop, spent a year with Leonard & Izard in construction work at Chicago, and was the balance of the time in the commercial departments of the Edison and General Electric companies. He resigned the position of assistant to S. Dana Greene, general manager of the lighting department, under whose charge he directed the isolated lighting business of that company. With such a fund of experience Warren & Lozier are well prepared for their venture.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued September 18, 1894.*

526,063. Multiphase Converter. Hermann O. C. Edmund Wagemann, St. Louis, Mo. Application filed July 5, 1892.

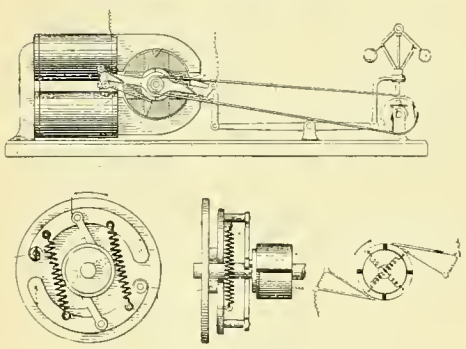
A multiphase converter has been constructed, special reference being paid to ventilation, insulation, economy of construction, and is one in which the windings can be differently disposed, in order to take the greatest advantage of the induced magnetic field.

526,064. Electric Generator. Hermann O. C. Edmund Wagemann, St. Louis, Mo. Application filed July 5, 1892.

The invention has for its object in the construction of alternate current generators a simple and inexpensive form of construction, adapted to generate a multiphase current, with comparatively short rotative diametrical dimensions, and in which the saturation of the field magnet is kept practically constant, to provide for the varying conditions under which the current generated by the machine is compensated for.

526,078. Electrical Connector. John B. Henck, Jr., Brooklyn, N. Y. Application filed July 6, 1894.

The improvement claimed relates to the class of devices intended to facilitate the ready connection and disconnection of electric conductors which are applied to uses requiring their occasional temporary connection, and especially those whose use may require the indiscriminate connection of any two out of an indefinite number of conductors.



NO. 526,169.

526,083. Electric Motor. Alexander W. Meston, St. Louis, Mo. Application filed August 1, 1892.

Some improvements in alternating motors are described, adapting them to be automatically self-regulating under different loads; to be sensitively and positively self-starting from all possible positions of the armature, even under a load; to be reversed to run equally well in either direction, and at the same time be susceptible of being set to run at different speeds, and to run for a comparatively long time without requiring attention.

526,099. Apparatus for and Process of Extracting Gold or Silver from Ores. Paul Danckwardt, New York, N. Y. Application filed April 2, 1894.

This invention relates to an improved apparatus and process for extracting gold and silver from ores by electrolysis, and consists in treating the ores in a finely pulverized state with a solution of cyanide of potassium and ammonium sulphide, or another alkali sulphide, and subjecting it simultaneously to the action of an electric current and an amalgamated cathode.

526,139. Telephone Transmitter. Henry L. Baldwin, Chicago, Ill. Application filed January 30, 1892.

The combination in a telephone transmitter in the circuit of a horizontal bar electrode, with a series of electrodes suspended by separate pendent arms from a horizontal rod, adjustable in position by means of slots and clamping nuts, is described.

526,141. Pneumatic Tube Fisher. Walter C. Bloomer, Brooklyn, N. Y. Application filed April 10, 1893.

The device patented is intended to enable persons to fish or draw a string through a continuous tube which may have a number of bends or angles, and by this means to safely adjust electrical conductors therein.

526,142. Bond for Electric Railways. Dwight D. Book, Brooklyn, N. Y. Application filed July 14, 1894.

The bond is so mounted that it cannot work loose, however great the amount of vibration of the rail ends, and it is also possible to increase the area of the joint to any desired extent, so as to compensate for the difference of conductivity of the bond conductor and rail.

526,145. Incandescent Electric Lamp. David J. Cartwright, Boston, Mass. Application filed January 27, 1894.

The invention relates particularly to the socket of an incandescent lamp, which is so constructed that it may be used for the support of lamps of any of the leading varieties of lamps now in use.

526,168. Signal Apparatus. George L. Thomas, Brooklyn, N. Y., and Edward C. Seward, Montclair, N. J. Application filed January 22, 1894.

This invention relates to an improvement in signal apparatus, and more particularly to a track instrument under the control of a passing train to set the signals for that train without disturbing the signals for a train running in the opposite direction upon the same track, and at the same time under the control of the train running in the opposite direction on the same track to set its own signals without disturbing the signals of the first named train.

526,169. Electric Motor. Elihu Thomson, Lynn, Mass. Application filed August 30, 1884.

In the cut is shown a motor consisting of an armature *A* and field magnets *F F*, suitably framed and supported. A commutator whose brushes are indicated at *B B* is provided. The brushes are here shown as movable around the commutator cylinder for the purpose of obtaining a commutator adjustment, but the same effect may be produced by changing the set of the commutator cylinder circumferentially as the shaft or (when the dividing spaces between the segments are oblique) by moving either the cylinder or the brushes longitudinally in a plane transverse to the plane of rotation. Driven by the same power which drives the motor and at the same relative speed is a governor *G* of the centrifugal type. This governor is attached as shown, so as to impart movement to a lever *L* upon increase of speed, and by the link *l* to set the brush holder and brushes *B B* to a new position. The extent and direction of movement to be imparted will depend upon the nature, proportion and relative strength of the field used, as also on the nature, proportion and peculiarities of the armature, and form therefore no definable part of the invention, excepting as before stated, that is to say, the extent and direction of movement on an increase of speed is to be such as to set the commutator into condition where the motor will be less efficient; or, in other words, there will be less effective pull on the armature for the same current under the increased speed. It is sufficient in all cases to determine the direction and extent or amount of change in the set of the commutator which lowers the speed and make the connections to accord thereto. Instead of moving the brushes it is sometimes preferable to adjust the commutator cylinder itself upon the shaft by means of a suitable governor and its connections. Such a modification is shown in the illustration.

526,170. Dynamo-electric Machine. David H. Wilson, Chicago, Ill. Application filed August 17, 1893.

For this device is claimed the combination in one machine of a motor and generator, the armatures of which are fastened to the same shaft, the field magnets of the motor carrying each a series and shunt coil wound so as to aid each other, the series coil being composed of resistance wire and used as the resistance, the field magnets of the generator carrying a shunt coil, part of which is composed of resistance wire and used as the variable resistance by which the generator is governed.

526,172. Electric Switch. Louis Winterhalder, Milford, Conn. Application filed February 17, 1894.

The switch described is adapted for a current of high voltage. The object is to construct the clamp from heavy or non-elastic metal, and to apply thereto a spring having a bearing on each of the leaves of the clamp, the tendency of the spring being to hold the leaves in contact with the switch pin or key which is inserted between their faces.

526,179. Signal Apparatus. John P. Coleman, Swissvale, Pa. Application filed December 2, 1893.

The invention has reference to that class of slots employed in connection with pneumatic switch and signal apparatus, and combines a signal, operating mechanism detachably connected to the signal, and a fluid pressure mechanism controlling the connection between the signal and its operating mechanism.

526,183. Trolley Wire Finder. Edward Gale, Peoria, Ill. Application filed January 15, 1894.

The inventor provides the trolley pole with a guard or protection, which, through the springing of the pole, will engage with the line wire whenever the contact wheel disengages therefrom, and thus prevent the pole from being thrown violently upward and injuring the line wire. Other improvements are provided.

526,182. Galvanic Chain. Friederike Fritsche, Berlin, Germany. Application filed May 12, 1894.

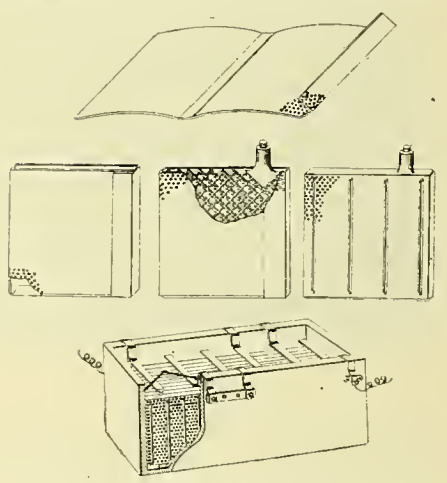
A chain adapted to act as a voltaic cell, consisting mainly of zinc and copper chains, with rounded links connected to each other alternately or in rotation by cords of absorptive material, whereby a slight and uniform electric current may be produced for action upon the body, is described.

526,220. Electric Indicator. Clyde J. Coleman, Chicago, Ill. Application filed December 8, 1893.

The invention consists of an electric indicating system comprising the combination of a standard cell, or other uniform source of electromotive force, a current measuring instrument, a variable resistance, and a resistance varying device consisting of a column of mercury, moving in constant contact and parallel relation with the variable resistance when affected by heat or pressure to reciprocally vary the degree of such resistance.

526,227. Electric Cut-out. Elmer E. Hersh, Denver, Colo. Application filed March 7, 1894.

A simple and efficient automatic fuse wire cut-out, in which the wire may be replaced after each operation, the improved cut-out being more particularly designed for electrically propelled cars, but capable of being used wherever a cut-out is necessary, is provided.



NO. 11,442.

526,356. Dial Transmitter. Frederick Pearce, New York, N. Y., and Joseph Broich, Brooklyn, N. Y. Application filed June 11, 1894.

In the invention the inventor combines with a dial transmitter, which may be regarded as the main dial, one or more auxiliary dials, the parts being so constructed and arranged that the signals sent in by the one or more auxiliary dials precede the signals sent in by the main dial, and the auxiliary dials come into action automatically; that is, to say, if two auxiliary dials are to be actuated, they are set, and the movement at the termination of the signal given by the first dial couples up the second auxiliary dial, so that its signal is sent in, and at the termination of the movement of the second auxiliary dial the main dial is coupled so that the signal is sent in by that, thereby allowing for sending in one, two or more auxiliary signals immediately preceding the main signal, so as to indicate what is wanted before the signal is sent in denoting the place to which the fire apparatus is to proceed.

11,442. Secondary Electric Battery. Charles Theryc and Alfred Oblasser, Paris, France. Application filed March 15, 1894.

The electrodes of the accumulator, shown in the accompanying illustrations, are surrounded by a perforated envelope, sheath or wrapper of an insulating material or non-conductor of electricity, composed of flexible or preferably rigid sheets of celluloid, India rubber, ebonite, gutta-percha, fibrolochoid, vulcanized fiber or other compound constituted by the same or other materials which are sufficiently good insulators. These envelopes have for their object to hold the active material, which enables the weight of heavy metallic supports or plates employed in Faure and other accumulators to be reduced, which supports were designed to contain the active material, and had to be thick enough for receiving a sufficiently large quantity of materials. After the active materials have been introduced into the envelope, surrounding a central rod or plate serving as a collector, the element thus constituted is subjected to the action of a hydraulic press in order to form a single piece. The pressure applied to the plate should be just sufficient to spread and distribute the active material evenly over the surfaces of the plate between it and the envelope, and to compress it uniformly. It is not advisable to use any greater pressure than will accomplish the purpose set forth, since excessive pressure, which renders the active material dense and compact, impairs the efficiency of the battery.

Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, OCTOBER 6, 1894. No. 14

## Power Transmission at Niagara Falls.

Much of a popular and technical nature has been written concerning the progress of the work at Niagara Falls, the prospects of the successful realization of the project and the benefits to be derived, both commercially and as an object lesson, from the utilization of the power of the great cataract. The readers of the WESTERN ELECTRICIAN, in the issue of October 15, 1892, were told in an illustrated and comprehensive article of the progress in the construction of the tunnel and general work, and subsequently the paper read by Prof. George Forbes before the British Institution of Electrical Engineers upon the subject and the discussion which followed, were presented in full. In addition to this articles have appeared from time to time treating of the progress of the work and the comments made upon the ultimate commercial practicability of the undertaking. It is needless to say that as the time approaches for the opening of the electrical power house, additional interest is manifested in the scheme, not only by the electrical world, which is deeply concerned in it from a mechanical and scientific standpoint, but by the business interests comparatively near the falls. This is particularly true of the business men of Buffalo, who perceive in the successful accomplishment of the ambitious plans of the promoters of the enterprise cheaper power, the multiplication of their city's manufacturing establishments, and a marked increase in the population of the city and in the price of real estate. The project of holding an electric carnival to inaugurate the actual transmission of power to Buffalo was announced and commented upon in the last issue of this journal, and it may be added that an energetic movement in this direction has been begun, which will undoubtedly be productive of much to interest the electrical fraternity.

At the power house everything is in readiness for the first shipment of electrical machinery, none of the generating apparatus having, as yet, been set up. Several of the dynamos are constructed, however, and will soon be received at Niagara Falls.

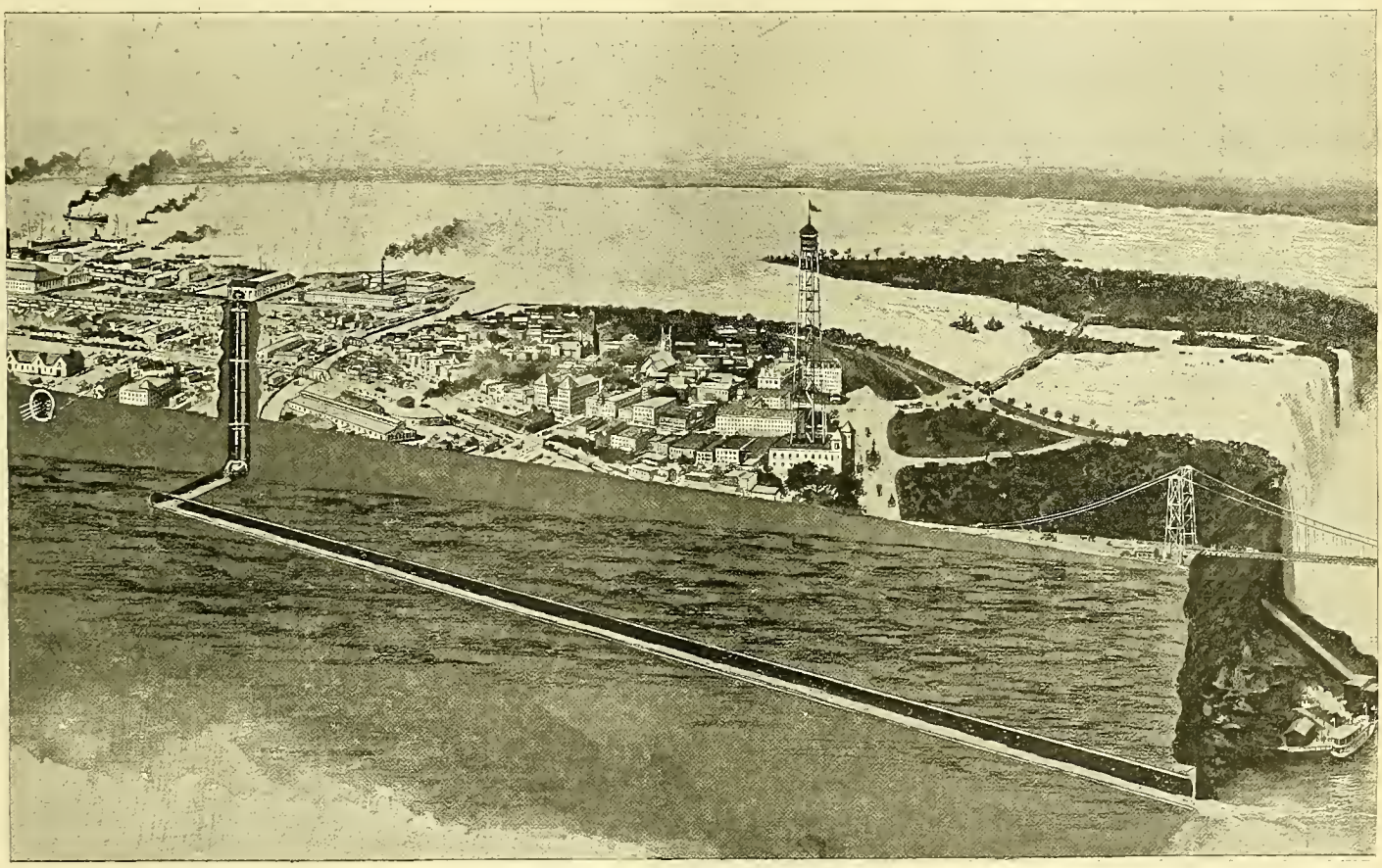
A recent important addition to the business interests of Niagara Falls is that of the Monongahela City, Pa., Carborundum company. This company has announced that it has selected a site for building a plant just east of that of the Pittsburg Reduction company and that the contract for power will be signed at once. This will call for 1,000 electrical horse power and an option on 10,000 horse power, should it be required. The company manufactures a powder which is used as a substitute for diamond powder and emery. It has a plant at Monongahela City and employs a large number of men. Its officers are: President, E. G. Achesen; vice-president, J. S. Huyler; treasurer, William McGregor; secretary, C. M. Hagen.

The accompanying illustration is of particular interest as showing the general plan of the hydraulic scheme and the magnitude of the tunnel, which has been excavated at a depth of 200 feet under the city of Niagara Falls and at a cost of $4,000,000. The wheel-pit is 178 feet deep, 21 feet wide and 140 feet long.

The tunnel is 7,250 feet long, 14 to 18 feet wide, 21 feet high, and the grade is 36 feet to the mile. Eight hundred tons of 30, 50 and 70 per cent. dynamite were used in blasting for the tunnel, and samples of each shipment were assayed at the Vandenbergh Laboratory of Buffalo. At the left in the picture is shown a portion of the Pittsburg Reduction company's plant, near which will be the manufacturing establishment of the Carborundum company. Below this is shown the location of the conduit planned to contain the wires leading to Buffalo. At the right of the wheel-pit is the sewage disposal works, in which refuse will be treated by precipitation. The capacity of this enormous tunnel is estimated as equal to the combined water power of Lawrence, Lowell, Holyoke, Turner's Falls, Manchester, Bellows Falls, Lewiston, Cohoes, Oswego, Paterson, Augusta (Ga.), Minneapolis, Rochester and Lockport.

In comparison with the carefully detailed paper of Prof. Forbes, dealing with the technical electrical features of the plans, the following general statements of the source from which power is drawn, the work accomplished, the general features and statistics governing the several factors which have combined to make this task one of the greatest engineering problems of the world, as well as a statement of the intentions of the companies which have been formed to distribute and utilize the electric power, written by William A. Brackenridge, engineer of the Cataract Construction company for the American Society of Civil Engineers, will be of great interest. Mr. Brackenridge has not always gone into any great amount of detail, but he has treated the subject comprehensively and with care. The field covered is too broad to admit of going into absolute detail, and the paper was not intended to arouse discussion of any description.

It is not intended to attempt more than to give briefly and in a very general way an idea of the manner of utilizing the great water power of Niagara and the methods adopted in the construction of the various works. Many of them being novel in their application may be of interest. The great lakes being the source of supply afford an appropriate point for beginning. These great inland seas form a chain reaching nearly half way across the American continent. The water surface of the lakes, with the exception of Lake Ontario, has an area of 84,400 square miles, the watershed of the lakes being 240,000 square miles, more than twice the area of Great Britain and Ireland, the length of their shore line and that of their connecting rivers being 5,000 miles. The volume of water in these lakes is 6,000 cubic miles, of which Lake Superior contains a little less than one-half. The outflow of the lake basin is about one-half of its rainfall, the average discharge at the outlet at Lake Erie being estimated at 275,000 cubic feet per second. This enormous body of water flows through the Niagara river from Lake Erie to Lake Ontario. Twenty-three miles below Lake Erie and fourteen and one-half miles above Lake Ontario the river plunges over a precipice about 165 feet high. At the falls the river turns abruptly to the north, making an angle of more than 90 degrees. Below the falls the river has a width of only 800 or 900 feet, while above the falls the width is about 6,000 feet. The depth below the falls is said to be about 189 feet, though in places the actual depth has never been accurately ascertained. Here the banks of the river rise to a height of 210 feet above the water level. The



POWER TRANSMISSION AT NIAGARA FALLS.

fall of the river from Lake Erie to the rapids above the falls is six feet, the descent of the rapids being about 50 feet. Between the falls and the lower suspension bridge there is a fall of about 10 feet, while at the latter point a rapid descent commences, there being a fall of 100 feet between there and Lewiston, including the whirlpool rapids. There is therefore a total difference of elevation between Lake Erie and Lake Ontario of about 326 feet. The volumes of water in the lakes to which the Niagara river forms the only outlet is such that it has been estimated that even if no rain fell the flow of the river would be continued at its present rate for 100 years, could the lakes be gradually drained. Such is the never falling reservoir from which the Niagara Falls Power

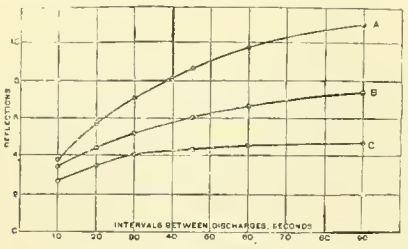



FIG. 1. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
First Residual Discharge.—Curve *A* for no previous charge; curve *B* for a previous negative charge for 30 seconds; curve *C* for a previous negative charge for 60 seconds.

company proposes to draw its supply. A glance at the topography of the Niagara river from Niagara Falls to Buffalo, and the towns along its banks, is interesting as showing the unusual advantages Niagara Falls offers as a commercial center. Here are the principal lines between the East and West, and here the Niagara river is navigable to the lower boundary of the company's lands, affording water communication with the great lakes, as well as with the seaports by the Erie canal. The city limits of Buffalo are distant only 12 miles by air line, and 16 miles by railroad. This city has a population of 300,000; its growth from 1880 to 1890 was equaled only by one city in the United States, and it is one of the greatest commercial and manufacturing centers in the country. Farther down the river are the

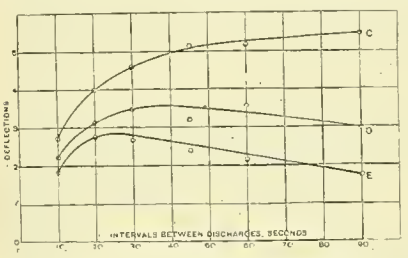



FIG. 2. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
First Residual Discharge.—Previous negative charge as follows: curve *C* 60 seconds; curve *D* 90 seconds; curve *E* 120 seconds.

towns of Tonawanda and North Tonawanda, forming one of the largest lumber markets in the United States. The State Reservation comprises, besides Goat Island and the smaller islands, a strip of land along the river bank extending about 5,000 feet above the falls, which includes all the points of vantage for viewing the falls and rapids. To avoid encroachment on this territory, and to take advantage of the fall of the rapids, it became necessary that the Niagara Falls Power company should select a site farther up the river. The company accordingly acquired about 1,600 acres of land stretching easterly to a point about five miles from the falls, and northerly three miles from the river. A portion of this

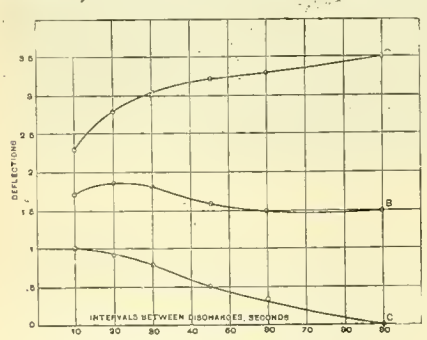



FIG. 3. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Second Residual Discharge.

property has been transferred to the companies associated with the Niagara Falls Power company, which are the Niagara Development company, the Niagara Junction Railway company, and the Niagara Falls Water Works company. The land now belonging to the power company, comprising 1,071 acres, is intended to be devoted to mill sites for the numerous factories that will be attracted by low priced and constant power and the many manufacturing advantages which are here offered. In order to provide suitable homes for the operatives in the factories, the Niagara Development company has purchased 340 acres of land, 83 acres of which are already improved. The Niagara Junction Railway company owns 168 acres of land and connects with all the existing lines of railroads at Niagara Falls, thus affording not only means of communication to the company's lands, but facilities for shipping over any of the many lines of railroads. The Niagara Falls Power company has also acquired the lands under water of the Niagara river adjoining its property. These lands will be filled to deep water, thus giving an uninterrupted dockage front of 12,000 feet. Docks have already been built. Freights may here be transferred to the Niagara Junction railway for distribution to the company's tenants, or for shipping by other railways. There are also passenger steamers connecting with the electric railway lines which furnish quick transportation to all parts of the city. The selection of the site of the central power station and canal at a point at the extreme westerly end of the company's lands was influenced by the desirability of making the tunnel as short as possible. On the Canadian side of the river is the Queen Victoria Niagara Falls Park. Here the Canadian government has granted the Canadian Niagara Power company the exclusive right for 100 years to devote a part of the park to the development of power in consideration of a yearly rental. This company will be in harmony with the Niagara Falls Power company. The combined

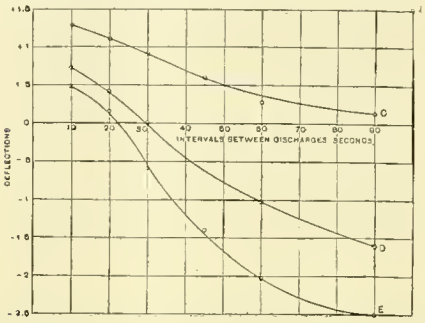



FIG. 4. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Second Residual Discharge.

power which these two companies may develop will be about 450,000 horse power.

While it is estimated that about 7,000,000 horse power is going to waste in the water passing over the falls, successful utilization of even a small portion of this power was found no easy task. Many plans were proposed and much thought expended on this subject for a long period of years. Among the first practical plans to be prepared were those of Thomas Evershed in 1886. The plan adopted is that of Clemens Herschel, prepared in 1891. The general plan resembles that of Mr. Evershed, although somewhat modified and changed to suit the conditions which confronted those who were wrestling with this great problem five years later. This plan contemplates a canal varying in width from 100 to 220 feet with a harbor 375 feet wide. Connection is here made with the river at both ends, there being a fall of about two feet between the upper and lower ends. The work that has been actually done on this canal is from the river at the lower end to a point beyond the power house. It was proposed by this plan to have two gate houses. The factories which demanded uninterrupted power were to be located outside of these gates, while those which did not require constant power were to be located between the gates. By closing the gates the water could thus be drawn from this portion to facilitate repairs. By

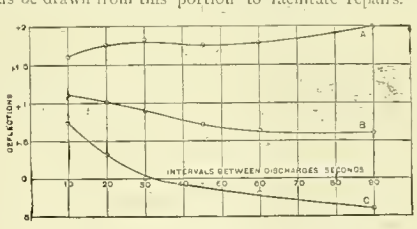



FIG. 5. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Third Residual Discharge.

opening the lower gate any ice which might have entered from the upper end could be carried down and discharged into the river. It is still an unsolved problem (only to be decided by the future advances of electrical science) as to whether the canal will be built for its entire length, or whether the power will be entirely developed from the canal as at present constructed, and thence sent far and near in the form of electrical energy. The plan of mill sites divided into blocks of 400 feet square may not be rigidly adhered to, but may be varied to suit the demands.

The right of way for a second tunnel has been secured, but its construction has not yet been commenced. On the west side of the canal there are at the south two inlets supplying water to the Niagara Falls paper mill. Next is the inlet for the water supply for the Niagara Falls Water Works company. Still further to the north are 12 inlets arranged in pairs, the part of the power house now constructed covering four of the latter. On the east side of the canal and half way down its length are six inlets where lateral canals will probably commence, and above this is a single inlet for an individual factory. The main canal is protected against floating ice by having its direction turned down stream, and by a floating boom fastened to iron piers at its mouth. The canal is 180 feet wide at the point of tangency of the curve on the west side, and diminishes to about 100 feet in a distance of 1,300 feet. The depth of the water in the canal will average 12 feet. The greatest velocity of the water at any point will be 4.17 feet per second, when a sufficient amount is being fed to the turbines to produce 100,000 horse power, the capacity of the tunnel. From these inlets the water is led through steel, cylindrical penstocks to the turbines, and is discharged into the channel in the bottom of the wheel-pit beneath the turbines and enters the main tunnel at an angle of 60 degrees through a short connecting tunnel having the same section as the main tunnel and thus into the lower Niagara river. The distance from this point of entrance to the portal is 6,763 feet. About 56 feet above this point the section of the tunnel is reduced, the reduction being made in a distance of 20 feet. A spur tunnel 10 feet

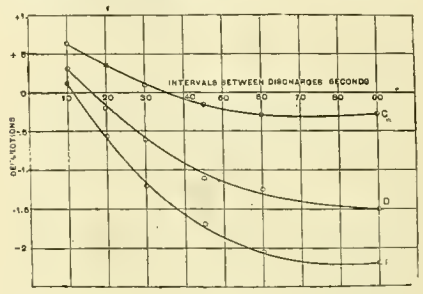



FIG. 6. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Third Residual Discharge.

in diameter enters near here for connection with another wheel-pit, which will be constructed later on. The main wheel-pit is rectangular in plan, 21 feet wide, and the part already constructed is 140 feet long. When continued to its full length to provide for the 10 inlets, it will be about 400 feet long. A strong bulkhead is built across the temporary end at the south so that the machinery already placed in position will be protected while the extension is being made. This will probably be done by channeling with power supplied by the turbines already in place.

The character of the rock was ascertained in advance by diamond drill boring. The tunnel for the greater part of its length passes through a slate formation. This slate disintergrates very rapidly when exposed to the atmosphere. It was found necessary to line the tunnel with brick for its en-

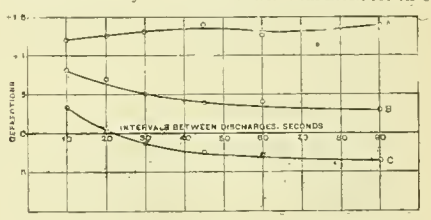



FIG. 7. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Fourth Residual Discharge.

tire length, and with timber, except for about 700 feet, where the roof was found to be of limestone. The shafts were sunk to a depth of from 196 feet to 210 feet. The portal shaft, which was built partially along the face of the cliff, was 10 feet by 12 feet in section. Shafts Nos. 1 and 2 were 10 feet by 20 feet and 2,433½ feet and 4,983½ feet; respectively, from the portal shaft. The velocity in the main tunnel when running at its maximum capacity will be about 26½ feet per second, thus taking 4½ minutes for water to flow from the wheel-pit to the river below. The heading between the portal and shaft No. 1 met on December 24, 1891, and that between shaft No. 1 and No. 2 on February 3, 1892, the 6,700 foot-point being reached during the same month. Rodgers & Clement of New York were the contractors for the construction of this part of the main tunnel.

Considerable difficulty was met with in sinking the shafts

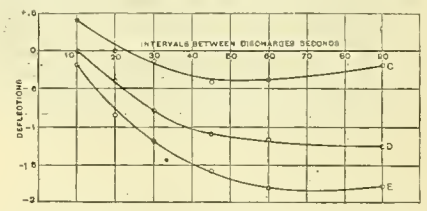



FIG. 8. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Fourth Residual Discharge.

on account of the large quantities of water encountered about 60 feet below the surface, the flow in shaft No. 2 being estimated at about 700 gallons per minute. To control this flow and to avoid pumping to an unnecessary height, a ring was cut around the shaft to a point 15 feet below the level of the maxium water flow. In this ring were placed wooden troughs running around the shaft leading the water to a lateral trough placed in two drifts 24 feet long, 10 feet wide and five feet high, each having a sump four feet deep at the inner end, from which the water was removed by a No. 7 Cameron pump. Canvas was stretched to intercept the water flowing on the inner sides of the shaft. The water was thus led into the sump and pumped to the surface.

The main tunnel is of the form of a horseshoe in cross-section, its inside dimensions being 21 by 18 feet 10 inches. The headings were commenced in June, 1891, and driven by the "center cut system," 18 holes 2½ inches in diam-

eter and about 8 feet deep being drilled, these holes being driven by Little Giant drills operated by compressed air under a pressure of from 80 to 100 pounds. Close to the end of the heading, timbers were set up, being replaced as soon as possible by the permanent roof timbers including the wall plate. About 50 feet behind the heading the first bench, 8 feet in height, was excavated, the wall plates being supported by plumb posts or inclined rakers which were afterward built in. A temporary track, extending from the heading to and over a part of the first bench, was supported by chains fastened in the side walls. Dump cars were run out on this and emptied into cars running on the bench below, which were drawn to the shaft and raised to the surface. Trains of cars were here made up and drawn by a locomotive to the upper river bank, where the material was deposited for filling along the river. About 30 acres of land were formed in this way. The second bench was excavated about 50 feet in advance of the brick side walls.

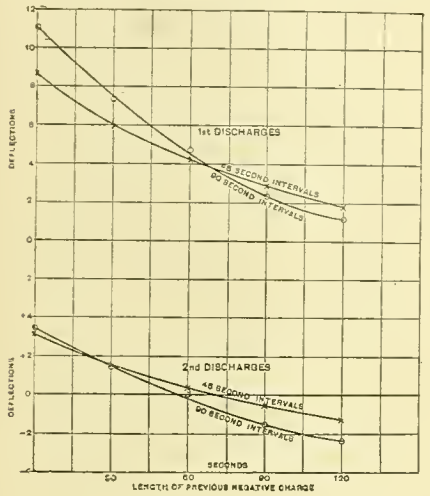



FIG. 9. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Effect of Previous Negative Charge upon Residual Discharges.

The side walls were the first of the brickwork to be built, being carried up 60 courses above the special brick at the bottom. Up to the 30th course from the bottom the masons worked on ordinary trestle scaffolds. After that point was reached a wooden floor was temporarily built at the level of the second bench to allow the cars to run through the tunnel on and below this platform. The side walls being completed, centers were placed in position, lagging being added board by board as the worked progressed. The last of the brickwork to be built was the invert, the bottom having been brought up to within one inch of the brick with concrete. Finally the shafts were lined up to the solid rock also at the top. The section of the reduced tunnel above the wheel-pit connection is similiar in form to that of the main tunnel, but has an area of section of only 195 square feet. The

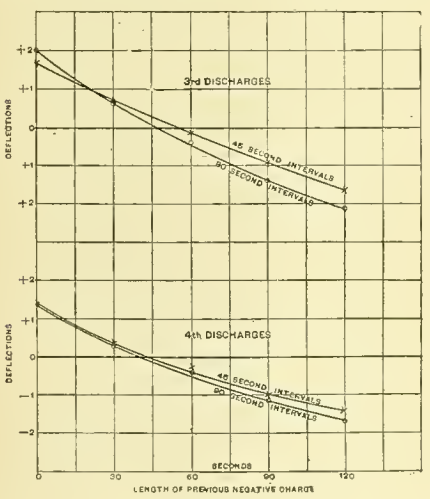



FIG. 10. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Effect of Previous Negative Charge upon Residual Discharges.

lower portion of the channel beneath the turbine wheels is similar in form to that of the main tunnel, but the side walls are built vertically and are about 16 feet apart. The tunnel of the Niagara Falls Paper company is of circular form 7 feet in diameter, and has a length of 687 feet and a slope of 2.44 feet in 100.

The sustaining arch of the main tunnel on top was made of 12 by 12 inch yellow pine timbers, resting on 12 by 12 inch wall plates, which in turn rested on 12 by 12 inch plumb posts. All the spaces between the brickwork and solid rock were carefully filled with rubble masonry to the 80th course, or about four feet above the wall plates, and above that point generally dry packing was used. Over 13,000,000 bricks were used in the lining, the brickwork being commenced about the middle of March, 1892, and finished in the latter part of August of the same year. The best progress made in any one week was 800,000 bricks laid. Buffalo bricks were used except in the top course of the invert, which was laid with vitrified paving brick. Special bricks were used where the side walls intercept the invert, their shape being such as to enable both to have a square bearing without cutting. The cement used in the mortar for this work was the Giant Portland cement, manufactured by the American Cement company of Philadelphia. Careful tests of this cement were made during the whole progress of the work, during which time over 3,000 briquettes were broken.

The main part of the tunnel having been completed, work near the portal was commenced. A drawing illustrating the construction of this portion for about 59 feet from the surface of the portal shows that the profile changes and takes the form of a reverse curve for a distance of 80 feet to a point from which it is level to the face of the masonry (which forms a facade) where it is 10.76 feet lower than at the beginning of the curve. The section of the tunnel was preserved throughout this part. The average water level of the river is 8.8 feet above invert at the point of discharge, though this is by no means constant, as there is a considerable rise and fall in the river at this point. In this construction there are 10 ribs composed of latticed girders having their plane at right angles to the axis of the tunnel and connected with five longitudinal girders, the spaces between them being solidly packed with concrete. These girders are riveted ¾ inch steel plates which are are carried up on each side to a point about two feet beyond the springing line. Above this point the ordinary brick arch was turned. At the extreme end a headwall of stone masonry 39 feet long and about 15 feet wide was carried down to the underlying sandstone.

The outer lattice cross girder or rib of the portal is composed of 4 by 6 inch angle flanges connected by 3½ by 3½ inch ribs, being 4 feet deep on the bottom, gradually diminishing to three feet at the top. Cut granite masonry extends from the face for from 11 to 19 feet into the tunnel, where it is connected with the brick. As a final protection there are cast-iron plates 5 inches thick with ribs projecting 18 inches, which are connected to the stonework by 1¼ inch bolts and to the girders by an expansion connection.

The inlets of the main canal are 14 feet wide. The canal walls are built of Buffalo limestone; they are 17 feet high, three feet wide on the top and batter, one in 12 on the face. The south end of the power house is temporarily enclosed, and will be extended to include the 10 inlets.

The power house was designed by McKim, Mead & White. The main part of the building over the wheel-pit is 69 feet

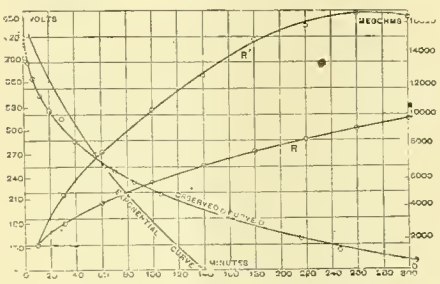



FIG. 11. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Condenser Discharge Curve and Computed Resistance.
(Condenser No. 3.)

8 inches wide and 36 feet 10 inches from water tables to eves; the length at present provides for four turbines. James Stewart & Co. were the contractors. The steel columns supporting the roof trusses also support girders on which a 50 ton electric crane runs the entire length of the building; this crane is for use in lowering machinery into the pit during construction, and to facilitate repairs after the works are in operation. To the left of the entrance will be the company's offices, now in course of construction. Above is a large medallion to bear the company's seal designed by Fred McMonnies.

About 40 feet above the connection of the tunnel leading from the wheel-pit to the main tunnel a branch tunnel enters. It is circular in section and 10 feet in diameter. The interception is made with granite. The chief characteristic of this piece of masonry is that the face is not a plane, but a section of a cylinder.

An electrical subway has been built through which is proposed to carry the wires for local distribution of the electrical current, while the more distant transmission will probably be accomplished by wires strung on poles. This conduit is built entirely of concrete, the walls being about nine inches thick and having cast iron brackets placed at proper distance apart to sustain the insulators carrying the wires. The dimensions are 5 feet 6 inches and 3 feet 10 inches. A space of eight inches deep at the bottom is allowed for drainage. Above this, resting on ledges, will be placed ties 3 feet by 6 inches, carrying a track on which will run a small car, screens on eight sides protecting the lineman from the dangerous currents. It has now been completed as far as the land leased to the Pittsburg Reduction company, which is erecting large buildings and proposes to use about 6,000 electrical horse power for the manufacture of aluminum.

The Niagara Falls Paper company enjoys the distinction of being the first to take power from the Niagara Falls Power company. This company built its own head-race, wheel-pit and connecting tunnel. The firm of Douglass & Johnson were the contractors. The same firm also built the wheel-pit tunnel extension and a part of the canal for the power company. The head-race is 300 feet long, 30 feet wide and 12 feet deep, a large gate-house being situated at its outer end. The wheel-pit is 28 feet 6 inches by 44 inches and 177 feet deep. The turbines are three in number, each being 58 inches in diameter, running under 144 feet head, making 260 revolutions to the minute, and generating 1,100 horse power each. The horse power is transmitted to the surface by a solid 10-inch forged iron shaft, with a pair of bevel mortise wheels on top which run 4,100 feet per minute. The water is carried to the wheels by one penstock 13 feet 6 inches in diameter, made of ¾ inch iron at the bottom, with butt and strap joints riveted in the pit. A 60 inch hydraulic gate valve is placed in the case between the gates and the penstock. The head-race, shaft, ironwork and tunnel are all built for the future, when 7,000 horse power may be used. The ironwork for the three wheels weighs 1,400,000 pounds. The tunnel, as already mentioned, is seven feet in diameter, lined with three rings of brick, and is 687 feet long, and has a slope of 2.44 per cent. The ten grinders of the wood pulp mill consume 275 horse power each and have a capacity of 4½ to 5 tons of pulp in 24 hours. The floor space of the mill covers 4½ acres, 6,000,000 bricks and 3,000 cords of stone having been used in its construction. The mill contains one 120 inch cylinder machine, the largest of its kind in the world, and two Fourdrimer machines, one 120 inch and the other 136 inch. The latter is the largest in the United States. The total capacity of the mill is 55 to 60 tons of finished paper and 45 tons of ground wood pulp per day. Nine hundred and twenty-five horse power of steam

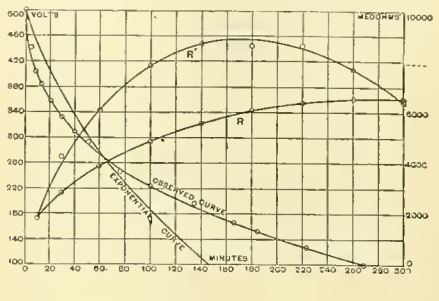



FIG. 12. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Condenser Discharge Curve and Computed Resistance.
(Condenser No 3.)

is used in addition to the water power for running the paper machines, this amount being consumed partly for drying and heating purposes.

The site of the power house in the Queen Victoria Niagara Falls Park is at the foot of the cliff below the Falls View station of the Michigan Central railroad. An inlet of the river has only to be enlarged and deepened to form a canal leading to the power house. It is proposed by this plan to build at first one power house 400 feet long, with a tunnel 1,400 feet long, a second power house of the same length as the first, with a tunnel 300 feet long being added in the future. The amount of power may be still further increased by the addition of a third power house with a tunnel 800 feet long leading to the river.

The Niagara Junction railway is an important factor in the general plan of development and forms an attractive feature to manufacturers locating on any part of the power company's lands. The main line, beginning at the west boundary of the property, runs parallel to the river and is centrally located through the land to the eastern boundary, where it turns north and continues to the extreme northern boundary, where connection is made with the Lockport branch of the New York Central railroad. Connection is also made with the main line of the New York Central at the western end, and with the Erie railroad at an intermediate point. Thus

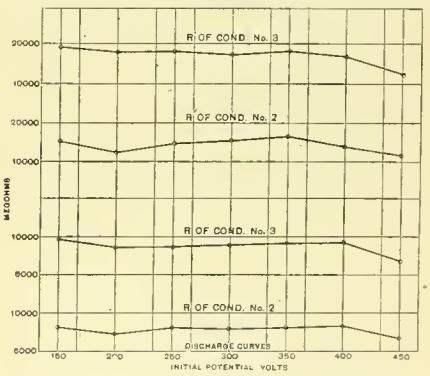



FIG. 13. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Average Resistance Corresponding to Different Initial Potentials.

a complete belt line is formed, encircling the whole city of Niagara Falls. Sidings are laid to the docks, and will of course be provided for each manufactory located within the boundaries of the power company's lands. There are 5½ miles of single track on the main line, and at present there are 2.68 miles of siding. The maximum grade is 1.06 per cent. and maximum curve 10 degrees. At present only a single track is laid, although the masonry of all the bridges provides for double track. In order to avoid a grade crossing with the New York Central and Erie railroads and a highway it became necessary to cross overhead by trestle and bridges.

Eighty-three acres of land will be devoted to homes for the operatives in the factories in the vicinity. On two sides of this tract are lines of electric railway leading from the steamboat dock to the business part of the city; on the south are the tracks of the New York Central and Erie railroads. The development of this land forms a most interesting study inasmuch as everything seemed to have combined to thwart its being devoted to the purpose for which it was intended, and for which its position so admirably adapted it. Around the entire boundary of this tract of 83 acres a dyke will be formed eight feet wide, with the top one foot above the

highest recorded water level. Just outside the dyke a ditch leads the water coming from the adjacent territory to the natural water course and then to the river. What was once a dreary waste of swamp land is now being rapidly transformed into a pleasing suburban village, and the inhabitants of Echota, secure inside its bounds, no longer ask the reason for the name which in the Indian language means a place of refuge.

The WESTERN ELECTRICIAN is indebted to the Vandenbergh laboratory of Buffalo for the accompanying illustration.

## A Study of the Residual Charges of Condensers and Their Dependence Upon Temperature.[1]

BY FREDERICK BEDELL, PH. D., AND CARL KINSLEY, A. B., M. E.

When a condenser is subjected to a difference of potential for some time, part of the charge received is absorbed by the dielectric and a part remains upon the surface of the condenser plates.[2] This latter part becomes discharged when

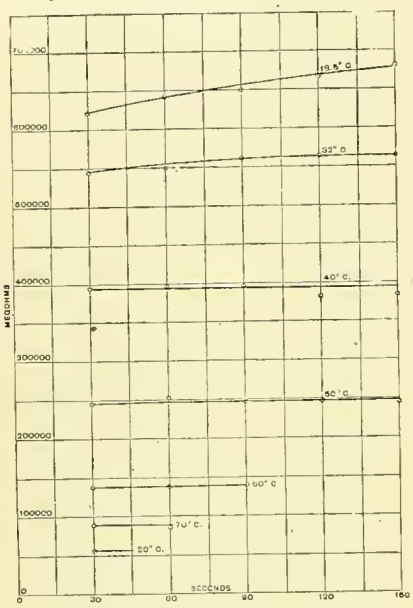



FIG. 15. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Resistance of Vacuum Oil at Different Temperatures.

the terminals of the condenser are connected together through a conducting circuit, and the condenser appears to be in a perfectly neutral condition. The absorbed charge, however, still remains in the condenser, and will gradually come to the surface in the form of a residnal charge of the same sign as before. If this be discharged, and the condenser be allowed to stand insulated, a second residual charge will collect in the same way as the first. A series of

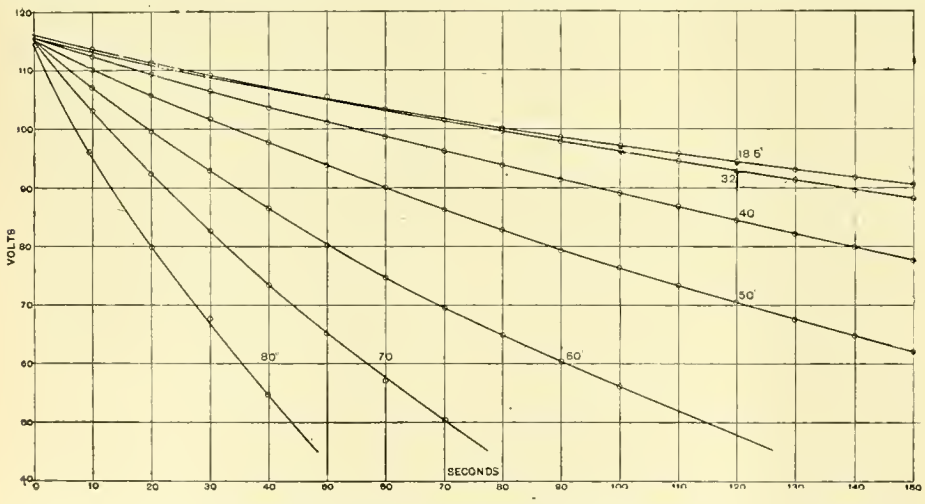



FIG. 14. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Discharge through Vacuum Oil at Different Temperatures.

residual charges with rapidly diminishing values may thus be formed. Therefore the condition of a condenser is dependent upon its past charges, some of which may have been held by the dielectric for weeks or even months before appearing upon the surface; a former charge of one sign may entirely neutralize a subsequent charge of opposite sign and smaller value. It has been justly said that the past history of a condenser must he known before it can be trusted.

1. Read before the American Institute of Electrical Engineers, September 19, 1894.

2. The part absorbed depends directly upon the duration of the time of charge: the part remaining on the surface is practically independent of the length of charge for the condensers used in the present investigation. This was shown in a preliminary investigation by W. M. raft and H. B. Henderson, who showed the first discharge, as measured by the throw of a ballistic galvanometer, to be independent of the length of charge.

The object of the present investigation was to determine this soaking-in effect of dielectrics. A study was made[1] first of the successive residual discharges of a neutral condenser and then of the effects produced by previously charging the condenser in the opposite direction. Figs 1 to 10, inclusive, show some results from this part of the investigation. The absorption by the dielectric was next studied by allowing a charged condenser to stand insulated and discharge through its own dielectric. The effect of a previous negative charge upon this absorption and upon the apparent resistance of the condenser was thus studied, as shown in Figs. 11 and 12. An investigation was then made of the influence of initial

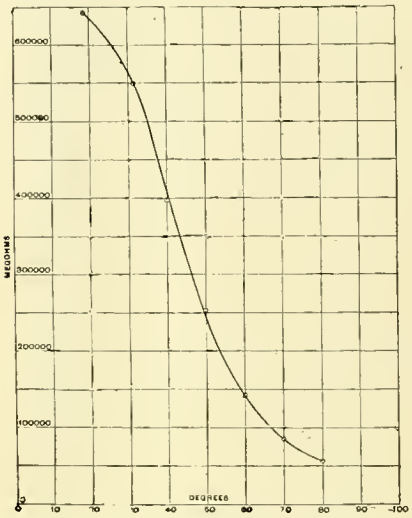



FIG. 16. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TMPERATURE.
Resistance of Vacuum Oil at Different Temperatures after 60-se ond Electrification.

potential upon the discharge curves and the insulation resistance, the results being shown in Fig. 13. An examination of temperature effects was then undertaken. The influence of temperature changes upon discharge curves through various commercial oils, and upon the resistance of the oils (see Figs. 14, 15 and 16), was ascertained preliminary to similar experiments upon condensers. Finally, the influence of temperature upon the absorption by the dielectric of a condenser was obtained by a study of the successive residual discharges, Figs. 17 and 18, and by discharge curves. Fig. 19, at different temperatures. We will discuss separately the several parts of investigation.

### THE EFFECT OF A PREVIOUS NEGATIVE CHARGE UPON SUCCESSIVE RESIDUAL DISCHARGES.

Previous to the final charge, the condenser was subjected, for this series of experiments, to a charge of opposite sign. The final charge was in every case in the same direction (arbitrarily called positive) and for the same length of time, that is, 30 seconds. Experiments were made with previous negative charges, that is, charges opposite in direction to the final charge, of different duration. The value of the positive or negative potential to which the condenser was charged was in all cases about 114 volts. After the final positive charge of 30 seconds, the condenser was allowed to stand insulated for five seconds, and was then short-circuited for 15 seconds. After this discharge by short-circuiting, the condenser was allowed to stand insulated for definite intervals of time, during which the absorbed charges worked out to the surface. It was then discharged through a galvanometer, the throw of which furnished a comparative measure of the discharges.[1] Successive residual discharges were thus obtained by allowing the condenser to stand after each discharge for an interval of time, during which the residual charges worked to the surface. The first, second, third and fourth residual discharges were obtained with equal intervals of time between the successive discharges. This was repeated, allowing different intervals of time between the discharges, and the results are shown in Figs. 1 to 8. In these figures, curves *A*, *B*, *C*, *D* and *E* represent the residual discharges corresponding to different lengths of previous negative charge. In the case of curve *A* there was no previous charge of any kind, the condenser being as nearly neutral as possible when the final positive charge of 30 seconds was given. The measurements for curve *B* were made upon the same condenser, which was given a previous negative charge for 30 seconds, was then allowed to stand insulated for five seconds, and then short-circuited for 15 seconds previous to the final positive charge. For curve *C* the condenser received a preliminary negative charge for 60 seconds, stood insulated for five seconds and was then short-circuited for 15 seconds previous to the final positive charge. For curves *D* and *E* the previous negative charges were 90 and 120 seconds respectively, all other operations being as before. The absorption, due to a positive charge, deflected the needle to the right, and such deflections are plotted, above the *X* axis; deflections to the left, due to a negative charge, are plotted below the axis. In taking curves *D* and *E*, the sensitiveness of the galvanometer was changed, and curve *C* was, therefore, determined twice, in order to show the relation between curves *A* and *B* and curves *D* and *E*.

The effect of the previous negative charge in partially or wholly neutralizing the final positive charge is clearly seen by an inspection of the curves. This influence becomes more and more marked with each successive discharge, and still more apparent as the intervals between the discharges are made greater. This would naturally be so, since the previous residual charge has time to work out and neutralize the absorption due to the final charge.

In the first residual discharge curves, Figs. 1 and 2, the previous charge has evidently the most influence where the intervals between discharges are the longest, and although the discharges are all positive, it is not at all unlikely that curves *D* and *E*, at any rate, would be brought to zero, or even made negative, by increasing the intervals between discharges.

In the curves for the second residual discharges, Figs. 3 and 4, curve *C* is brought to zero, while curves *D* and *E* ac-

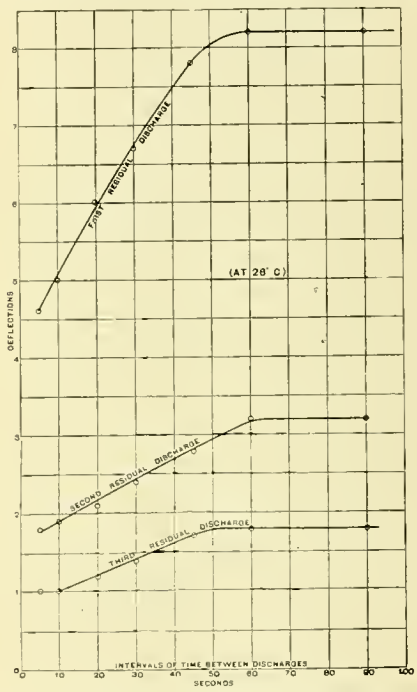



FIG. 17. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Residual Discharges of Condenser at 26° C.

tually cross the *X* axis, indicating a negative discharge; that is, one opposite in direction to the final charge. The evident turning again of the lower part of the curves indicates that the previous negative charge is becoming weakened.

All these effects are more marked in the curves for the third residual discharges, Figs. 5 and 6, where, in the case of curves *D* and *E*, the 10-second interval is the only one giving a residual discharge in the direction of the final charge. These curves are very nearly of the form which they would have if the final positive charge had not been given to the condenser at all, and the residual discharges were due only to the previous negative charge, as is more plainly seen by inverting the figure As is usual, the fourth residual discharge curves are rather flat, but curves *D* and *E*, as they indicate the presence of merely a negative charge, resemble the usual second discharge curves and are considerably concaved toward the *X* axis.

The fifth and sixth discharge curves were obtained, but were not sufficiently marked to warrant reproduction; they merely emphasized the foregoing observations.

The curves shown in Figs. 9 and 10 are obtained from the preceding curves, and show the effect of a change in the length of the previous negative charge given to the condenser before the final charging. The residual discharges, as measured by the throw of the galvanometer, are represented as ordinates, and the lengths of the previous negative charges as abscissæ. Two sets of curves are drawn, obtained

1. The condensers used throughout these experiments were furnished by Mr. Stanley in the spring of 1893, and were used in the experiments upon "Hedgehog Transformer and Condensers," described in a paper before this Institute, October 18, 1893. For their construction see *Transactions*, vol. x., p. 514.

with intervals between the successive discharges of 45 and 90 seconds, respectively. In the case of the curves corresponding to intervals of 90 seconds, the residual discharges decrease with the increase of the previous negative charge, more rapidly than for the corresponding curves taken with 45 second intervals between the successive discharges. This is in accordance with the interpretation of the previous results. These curves show plainly that the absorption of the previous negative charge becomes greater as the time of this charge is increased; and the smoothness of the curves would indicate that the dependence of absorption upon time follows some definite law. The curves would probably be asympotic to some line determined by the condition of the condenser and the nature of the dielectric. This line would then represent the limit to the amount of absorption.

The reflex nature of the curves, particularly of $D$ and $E$,

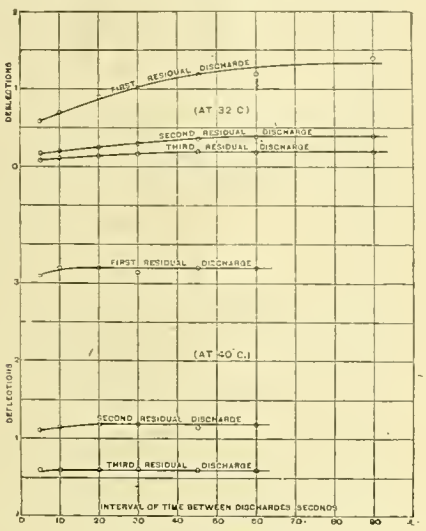



FIG. 18. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Residual Discharges of Condenser at 32° C and 40° C.

Figs. 4 and 6, suggested that they might be made to again cross the axis of $X$ if three charges were given them, the first being in the direction of the final charge. This was done, and upon short-circuiting the condenser and then taking residual discharges at 10 second intervals, the galvanometer first showed positive, then negative, and finally again positive residual discharges.

With longer intervals between discharges it was found that residual charges of opposite sign more thoroughly neutralized each other. Hence, a condenser, if charged in both senses for different periods, would show before long a residual discharge merely in the direction of the greatest absorption. If the period were made long enough this would likewise leak away, and the curve would approach

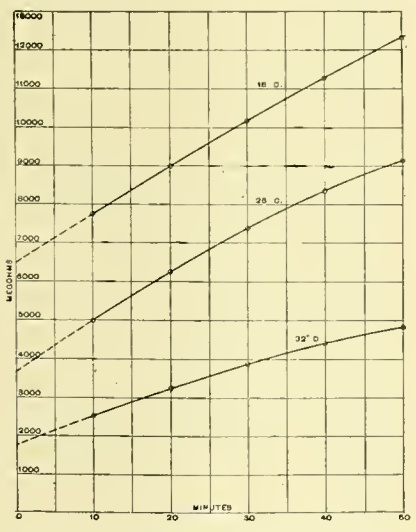



FIG. 20. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Condenser Resistance after Different Times of Electrification at Different Temperatures

the axis of $X$, although, probably, the condenser would never become absolutely neutral.

THE EFFECT OF ABSORPTION UPON THE DISCHARGE CURVES.

The curve for the discharge of a condenser through its own dielectric deviates widely from an exponential curve on account of the absorption of charge in the dielectric; for, as a condenser discharges, this residual charge works out to the surface and becomes effective. The form of the discharge curve depends likewise upon previous charges, whether of the same or of opposite sign. The resistance of a condenser is similarly dependent upon this absorption.

The discharge curves of the condenser were obtained by measuring the difference of potential at its terminals, by means of a multicellular voltmeter, as the condenser was allowed to discharge through its own dielectric. The leakage through the voltmeter was found to be negligible. Assuming that the discharge of the condenser follows the exponential law, we have where $V_0$ represents the initial potential; $V_t$ the

$$V_t = V_0 \varepsilon^{-\frac{t}{RC}}$$

potential at some time $t$ counted from the beginning of discharge; $C$ the capacity of the condenser; $R$ the insulation resistance, and $\varepsilon$ the base of the Napierian logarithms. This gives

$$R = \frac{t}{C \log_{\varepsilon} \frac{V_0}{V_t}}.$$

This value of the resistance is the value which would be true if the discharge curve were exponential from the beginning of discharge to the time $t$.

The resistance may be otherwise computed by taking brief intervals of time and assuming the curve to be exponential for this time. Thus, if $V_1$ and $V_2$ are the potentials at the times $t_1$ and $t_2$, we have

$$R' = \frac{t_2 - t_1}{C \log_{\varepsilon} \frac{V_1}{V_2}}.$$

The value of the resistance thus obtained, which we will call $R'$, is a closer approximation than the resistance $R$ obtained above, and becomes more nearly a true value for the apparent resistance of a condenser as the interval between $t_1$ and $t_2$ is shortened.

In Fig. 11 is given the observed discharge curve from a condenser, which, although used for some time, had always been charged in the same direction. An exponential curve is also plotted with the assumed constant resistance of 4,250 megohms. The derived curves showing the variation of the resistances $R$ and $R'$, obtained as explained above, are also given.

This condenser was left short-circuited for 88 hours, and then charged in the opposite direction and the curve of discharge obtained as above. The results are shown in Fig. 12. The previous charge affects the shape of the discharge curves, but its influence is more clearly seen in the curves for the variation of resistance. The increase in apparent resistance, shown in Fig. 11, is due, as has already been explained, to

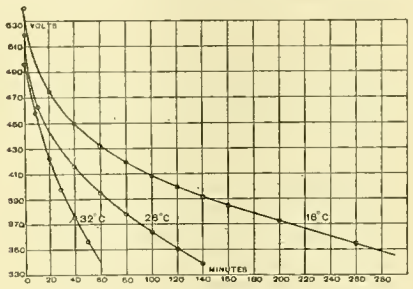



FIG. 19. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Condenser Discharge Curves at Different Temperatures.

the absorption in the dielectric. In Fig. 12 the resistance increases at first, due to the absorption of the final charge, and then decreases as the previous absorption of opposite sign begins to be effective. From this it is evident that the soaking-in effect, which is the cause of the usual rise of resistance, must have acted in the opposite direction, and so must have hastened instead of hindering the discharge. Where the curve for resistance $R'$, calculated for short intervals of time from the discharge curve, is horizontal, the two absorbed charges neutralize each other, the resistance is constant and the discharge curve is truly exponential.

The exponential curves, of course, cross the actual discharge curves when the resistance of the condenser is the same as the constant resistance assumed for the exponential curve. The resistance assumed in the case of an initially neutral condenser should be so small that the exponential curve would lie entirely below the observed discharge curve, inasmuch as the apparent resistance is increased by the coming out of the charges previously absorbed.

THE INFLUENCE OF INITIAL POTENTIAL UPON THE AVERAGE RESISTANCE.

To show more definitely that the departure of the discharge curve from an exponential form and the variation of resistance were due to absorption, and were consequently functions of the time rather than potential, discharge curves were taken through a wide range of initial potential, and the average resistance calculated by taking the mean values of the resistances obtained after 60, 160 and 260 minutes, according to the two methods above explained. Two condensers were used to check the accuracy of the work. The results agree throughout, and show a practially constant resistance throughout the range of initial potential employed, viz., from 150 to 450 volts, as shown in Fig. 13. The condensers were designed to stand a pressure of 500 volts, so we may conclude that while the insulation remains unstrained the changes which occur are due to what may be termed local causes—such as the conditions of the atmosphere and of previous charge—rather than to the initial potential of the condenser.

THE EFFECT OF TEMPERATURE UPON THE RESISTANCE OF OILS.

The foregoing results show the effects of absorption in a solid dielectric. The results which follow show that the absorption in ordinary dielectrics, as shown by the residual discharges and the curves of discharge of a condenser through the dielectric, are closely dependent upon temperature changes, and that at high temperatures. An investigation of the effect of temperature changes upon the resistance of various commercial oils (the effects of absorption and residual discharge disappear entirely) was made preliminary to a similar investigation upon solid dielectrics. The experiments for the determination of these temperature effects were conducted under the direction of one of us by E. G. Gilson and E. G. Mason, and are described at length in their report[1] upon the work.

In perfect oils there should be no absorption of charge, and the curves for the discharge of a condenser through such oils should follow the exponential law. Two surface plates were immersed in the oil experimented upon; these plates were 25.25 centimeters long by 17.5 centimeters wide, and were separated by three hard rubber pillars 1.47 centimeters high. The

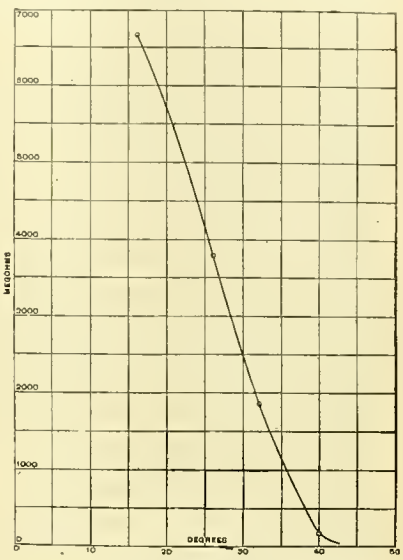



FIG. 21. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Condenser Resistance for Different Temperatures after Three Minutes of Electrification.

resistance of the oil was determined by discharging a condenser of known capacity through the oil by connecting the terminals of the condenser to these two surface plates. The potential at the terminals of the condenser was measured by a multicellular voltmeter and the resistance computed according to the exponential law. The resistances of the rubber pillars, the multicellular voltmeter and of the

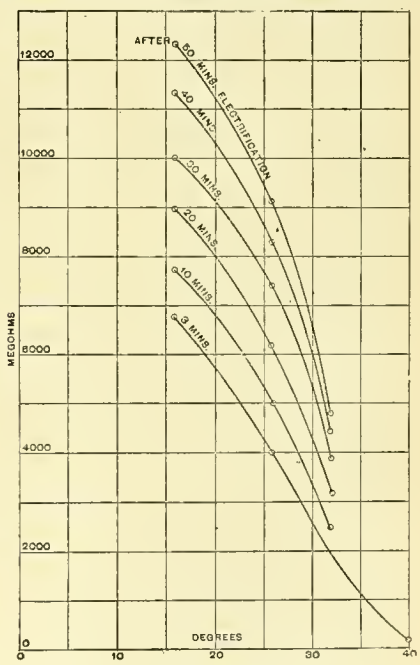



FIG. 22. A STUDY OF THE RESIDUAL CHARGES OF CONDENSERS AND THEIR DEPENDENCE UPON TEMPERATURE.
Condenser Resistance for Different Temperatures after different times of Electrification.

condenser insulation were so small compared with that of the oil that no correction for them was found necessary.

The results for different oils were similar and curves are, therefore, given for vacuum oil alone.

Fig. 14 shows the curves for the discharge of a condenser through vacuum oil at different temperatures. The temperature of the condenser and its capacity were constant. The resistance of the oil computed from the discharge curves according to the first method already described is plotted in Fig. 15. For the lower temperatures there is a

1. See MS thesis in the Cornell University Library, 'Effects of Temperature upon Dielectrics," by E. G. Gilson and E. G Mason.

[*Continued on page 163.*]

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A PRESS dispatch from Washington announces that Second Assistant Postmaster-general Nelson is giving considerable attention to special mail service in large cities. He has ordered the preparation of maps of all large cities showing the surface car lines, with a view of having mail cars run over them. He expects to give his attention especially to carrying mail on electric cars which run from centers of cities to the suburbs and to adjoining smaller towns. Cable roads may be utilized where possible. Mr. Nelson is of the opinion that only on electric lines running long distances will it be profitable to carry the mails. The experience gained in Brooklyn has confirmed the belief of the local officials that the project is feasible, and in many other cities, Chicago especially, the proposed improvement is very popular.

STUDENTS of statistics will find much to interest them in the figures presented in another column on the trolley in Brooklyn. Probably nowhere in the country has the electric motor been so vigorously opposed as in that city, and it is certain that in no other city have the projectors been so unfortunate in having the introduction of the trolley accompanied by so many accidents. These were not entirely due to faults on the part of those in charge of the work; in fact it is now admitted that a large proportion of the fatalities were the result of carlessness on the part of the victims. At the time, however, this was not considered, owing largely to the attitude of the newspapers toward the new system. Yet the work was completed, and despite the opposition which was at first manifested the people were won over to the trolley merely through the superiority of the service which it afforded. It was certainly a great victory and gratifying to those who advocated the improvement. In no way can the importance of this change of sentiment be so clearly understood as by a careful study of the figures presented elsewhere in this issue.

ST. LOUIS has taken up the matter of burying its electric wires, and already the subject is involved in many complications. The subway commission has proposed a plan for a general subway, in which all the companies may be accommodated, but the companies do not want to be thus cared for; in fact, each corporation seems determined to pursue an independent course. The telegraph companies are opposed to placing their wires in the same conduits with the light and power circuits. One of the lighting companies claims that it has a state charter, granted in 1857, which gives it the right to build its own conduits and bury its wires without a franchise from the city. From present appearances St. Louis is going to have the same experience as other large cities that have passed through the crusade against overhead wires.

IN addition to the regular programme of the Atlanta meeting of the American Street Railway association, announcement is made of several special features, which will add interest to the proceedings. Not the least of these is a paper on "A Practical System of Long-distance Electric Railway Work." This is a subject that is particularly timely just now, and one in which steam railroad men are showing much interest. Possible competition seems to have awakened a lively interest in this matter. Another practical paper on "Destructive Arcing of 500 Volt Fuses" is promised. These features are in addition to the regular programme, which also includes a number of reports on electrical topics. The thirteenth meeting of the association promises to be an interesting gathering, especially to electric railway men.

IT seems as though some perverted genius were at work inventing new forms of accidents in which the overhead trolley car may figure. In Brooklyn the other day a number of men were engaged in digging holes in the street to discover a leak in the gas mains. One of them made an excavation three feet deep between the rails of an electric line, and at this depth found much escaping gas. A car came along, but the gas had increased to such an extent that the workman sprang out of the hole, instead of crouching down until the car passed, as he had done before. It was fortunate that he adopted this precaution, for as the car passed over the hole the escaping gas was ignited by the sparks at the motor brushes and rushed up in a sheet of flame on either side of the car, with a loud report. The passengers were very much frightened, of course, and some of them jumped from the car, which was quickly stopped. It was found, however, that no one was hurt and that the car was uninjured. The flame rose to a height of ten feet and could not be extinguished before the gas was turned off. The workman was congratulated on his narrow escape from serious injury, and the mishap was added to the list of "trolley car accidents." Of course the fault was entirely that of the defective gas main, and many similar accidents, in which electricity played no part, can be recalled. Nevertheless it will not be surprising if the incident is made to do service as illustrating an added terror of the "deadly trolley." Prejudice, and not reason, is largely the basis of the opposition to the overhead trolley system.

THE attention excited by the sudden death of Miss Belle White of Chicago while undergoing electrical "treatment" for the removal of freckles will serve to emphasize the caution which should be exercised in the employment of electricity for any remedial or surgical purpose. It is certain that the electrical part of the process was not directly responsible for the young woman's death, which was due to a latent affection of the heart, but the lesson to be gained is that no long continued application of electricity, however slight the current, should be made upon the human body except upon the advice of an experienced practitioner of medicine. There may exist constitutional weaknesses, especially in women of nervous temperament, which should be located and guarded against before electricity is used. In the case of Miss White, who is said to have been a beautiful girl, with little need to make such a terrible sacrifice to vanity, a slight battery current was applied to the skin to be removed through moistened sponges. The skin was first thoroughly cleaned and then rubbed with a solution of cocaine to deaden the sensibility to the shock. The theory is that the offending bit of cuticle will be burned away, and that, after a number of applications, skin free from blemishes will appear. This "treatment" was practiced upon Miss White at a "facial massage" establishment by a woman without a medical diploma. Before leaving the office the patient dropped dead. The inquest revealed the fact that death was due to a functional disorder of the heart; but who shall say that the young woman would not now be alive were it not for the excitement due to the electrical "treatment"? Electricity is enshrouded in the popular mind with a strange terror, and fear of it has proved fatal before this. It should not be administered save under the supervision of a qualified physician.

CHICAGO, in addition to the possession of the largest isolated lighting plant in the country, will soon become noted for its large power stations for electric railways. The new work or extensions now in process of construction may be summarized as follows: South Side surface system, Wabash avenue and Fifty-first street, 7,000 horse power; Metropolitan Elevated road, Van Buren and Throop streets, 6,000 horse power; West Side surface system, Washington boulevard and Western avenue, 7,000 horse power; North Side surface system, California avenue and Roscoe boulevard, 6,000 horse power. This list may be made still more imposing by mention of the large Harrison street central station of the Chicago Edison company, with 10,000 horse power, while the Northwestern elevated road for the North Side will doubtless require a large plant. When to these are added the various outlying stations of the Chicago Edison company and the high-tension plant at Market and Washington streets, the arc lighting stations of the city of Chicago and the park commissioners, as well as the hundreds of smaller installations scattered about the city, an idea can be formed of the amount of electricity that is, or shortly will be, generated in Chicago day by day. Of course all these plants will never be operated to their full capacity at the same time, but if there were any method of ascertaining the actual daily consumption of electricity in light and mechanical energy the total would be something enormous, especially if the computation were postponed until all the electric railways now in process of construction had been completed. Nearly every American system of dynamo design is represented in these stations and at least one of foreign origin. The opportunity of practical study offered to the electrical students of the technical schools in and about Chicago by the existence of these great generating plants is exceptional, and is not the least of the advantages accruing from the conspicuous electrical activity of the city.

JUDGING from the attitude assumed by a railroad journal in a recent issue, the establishment of projected long-distance trolley lines between several of the large cities, which has been attracting public attention for some time, is looked upon as an invasion of the rights of existing companies. The same paper bewails the fact that an electric line from Philadelphia to New York, with branches making a total of 150 miles, is proposed by a newly organized company; that an enthusiastic prospectus with map shows another from Philadelphia to Harrisburg, a distance of 105 miles, running most of the way by the side of the Pennsylvania railroad, with proposed branches making up a system of 364 miles, of which 50 miles is already in operation; that the ambitious scheme of an electric railway system between Pittsburg and Chicago, with numerous branches, is on foot, the articles of incorporation providing for "freight, express and passenger traffic, and the carrying of the mails," and that lines to connect several widely separated cities in Ohio and Indiana are being seriously advocated. As an example of what may be expected to follow the introduction of the trolley system in a territory where a steam road has been running, the following excerpt from the report of the New York, New Haven & Hartford Railroad company is given special prominence:

> The construction of electric railroads in the neighborhood of our property continues throughout all its territory. Wherever they seriously reduce the revenue of this property we shall be compelled to lessen local service in a corresponding degree, as pointed out in our last annual report.

Undoubtedly this result will follow, for, as has been frequently pointed out, when steam and electric roads are brought into direct and active competition it has been invariably at the cost of the former. However, it must be borne in mind that the traveling public has certainly the privilege of choosing its method of transportation when more than one means are offered, and that it will not be likely to endorse the sentiment of the following remarkable statement with which our contemporary closes its article: "Altogether, the rapid increase of trolley roads is a problem for legislation of very grave importance to the public as well as to the existing lines of transportation that have built up the business upon which, for the most part, these new roads expect to live." The public is always the gainer by competition, especially in railway traffic, both by enjoying cheaper fares and better service. When the steam roads cease to furnish satisfactory service because of the advent of the trolley lines it will be an admission of superiority of the latter system, and will serve as an impetus to renewed activity in long distance electric railroad construction.

## A Study of the Residual Charges of Condensers and their Dependence Upon Temperature.

[*Continued from page 161.*]

slight increase in the resistance during the discharge. This has already been commented upon in the case of solid dielectrics, and indicates that there has been some absorption, possibly due to impurities in the oil. That the resistance is more nearly constant, and the discharge curves exponential at the high temperatures, indicates that absorptive effects disappear at these temperatures.

Fig. 16 shows the resistance of vacuum oil at different temperatures after an electrification[1] of 60 seconds. This decrease in resistance is most rapid between 30 degrees and 60 degrees, where the resistance diminishes over 80 per cent. The same phenomena were observed in the experiments with boiled linseed oil, petroleum oil and cylinder oil. The results are given in the accompanying tables:

RESISTANCE IN MEGOHMS OF 1 CU. CM. OF VACUUM OIL.

| Time in Secs. | 18.50° | 32° | 40° | 50° | 60° | 70° | 80° |
|---|---|---|---|---|---|---|---|
| 30 | 622,000 | 547.550 | 395 000 | 247,500 | 139,200 | 91,250 | 58,600 |
| 60 | 643,500 | 549,300 | 396 500 | 252,500 | 140,100 | 88,000 | |
| 90 | 649 900 | 560.000 | 396,600 | 249,500 | 142,000 | | |
| 120 | 666 000 | 564,500 | 384,000 | 249 000 | | | |
| 150 | 682 000 | 564,000 | 383,500 | 245.000 | | | |

RESISTANCE IN MEGOHMS OF 1 CU. CM. OF CYLINDER OIL.

| Time in Secs. | 20° | 40° | 50° | 60° | 70° | 80° | 90° |
|---|---|---|---|---|---|---|---|
| 30 | 141,100 | 136,000 | 78 200 | 60,300 | 40 830 | 36 830 | 37,120 |
| 60 | 141.000 | 140.950 | 78,750 | 63,200 | 42,700 | 38.750 | 39 300 |
| 90 | 162.950 | 142 500 | 80,550 | 64,200 | 53,600 | 39,550 | 40.450 |
| 120 | 165,800 | 146,900 | 82,100 | 63,950 | 44,220 | 40,310 | 40,500 |
| 150 | 185,200 | 148.100 | 83.600 | 64,900 | 44,550 | 41 850 | 41 650 |

RESISTANCE OF BOILED LINSEED OIL.

| Time in Secs. | Resistance in Megohms. | | |
|---|---|---|---|
| | 20° | 30° | 40° |
| 10 | | 1,263 | 770. |
| 30 | 2 310 | 1 181 | 1,084 |
| 60 | 2,310 | | |

RESISTANCE OF PETROLEUM OIL.

| Time in Secs. | Resistance in Megohms. | | | | |
|---|---|---|---|---|---|
| | 13° | 20° | 30° | 40° | 50° |
| 30 | 44 700 | 38,900 | 28,150 | 20,200 | 14,200 |
| 60 | 45. 50 | 39,900 | 28 210 | 19,740 | |
| 90 | 46,550 | 40 850 | 28,720 | | |
| 120 | 47,150 | 40 200 | | | |
| 150 | 47.550 | | | | |

TEMPERATURE EFFECTS UPON SOLID DIELECTRICS.

For this investigation the same condensers were used as in the experiments described in the earlier parts of this paper. An investigation of the dielectric hysteresis of these condensers and the effects of temperature upon capacity have already been described at length in a paper[2] in the *Physical Review*, where a detailed description of the condensers is also given.

A determination of the capacity of the condenser was made in connection with these earlier experiments, and also during the present investigation a year later. The values are here given for comparison:

| Condenser. | No. 2. | No. 3. | No. 4. |
|---|---|---|---|
| Capacity (microfarads) in 1893 ... | 1.571 | 1 52 | 1 539 |
| Capacity (microfarads) in 1894.... | 1 592 | 1.535 | 1 554 |

The measurements were made in each case by the method of mixtures, but with different apparatus, so that some of the variation may be due to the change of standards. The condensers, however, had stood severe treatment, being in continual use for a year under all sorts of conditions and a slight change of capacity might be looked for.

*Temperature Effects upon Residual Discharges.*—The first, second and third residual discharges were obtained at different temperatures by the method used in the experiments already described. The sensitiveness of the galvanometer was not kept constant, so that the deflections cannot be compared so as to show the relative values of the absolute quantity of electricity constituting the residual discharges under different conditions. The shape of the curves plotted in Figs. 17 and 18, however, indicates the relative amount of absorption at different temperatures, which is the point in question.

The residual discharges at 26° C. show a large amount of absorption, as it took long intervals between discharges to equalize the residual discharges.

Residual discharges at 32° C. give curves much flatter; the interval between discharges does not largely affect their amount. Residual discharges at 40° C. give remarkably flat curves, the intervals between discharges having, practically, no effect upon the discharges. This indicates that there was but little absorption. Whatever residual charge there was so readily passed out that a large increase in the intervals between discharges did not affect the quantity of the residual discharge.

These experiments show conclusively that absorption, as shown by residual effects, disappears at high temperatures.

*Temperature Effects upon Discharge Curves and Insulation Resistance.*—The insulation resistance of a condenser was obtained by allowing the condenser to discharge through its own insulation, and then solving the usual exponential equation for the resistance. The capacity of the condenser at different temperature was known as the result of the experiments already referred to.

The discharge curves at different temperatures are given in Fig. 19; the differences are due, however, to change in both capacity and resistance.

The variation in resistance during the discharge, computed according to the first method before described, is shown in Fig. 20, and is to be compared with Fig. 15, which shows the corresponding results for vacuum oil. Fig. 20 shows that the resistance remains more nearly constant at high temperatures. Inasmuch as this variation of resistance during discharge is due to absorption, it is evident that there is less and less absorption as the temperature rises, a conclusion already reached from a study of residual discharges.

The condenser resistance at different temperatures, after three minutes of electrification,[1] is given in Fig. 21, and is in form quite similar to the corresponding curve for vacuum oil Fig. 16. The sudden bend in a curve after 40° corresponds to the rapid changes in capacity at these temperatures. Between 42° and 50° the capacity increases very rapidly. When the capacity becomes infinite, the resistance will, of course, be zero.

M. A. Hess read a paper before La Société Francaise de Physique, a review of which appeared in *L'Electricien*, January, 1894, in which he says in speaking of the phenomena of absorption: "If the product of the capacity and resistance of different portions of the dielectric sheet are equal, there will be no residual discharges. * * * It has been observed that the insulation diminishes when the temperature rises. * * * From this it is seen that there is a temperature at which the phenomena of the residual charge disappears."

In Fig. 22 curves are drawn after different times of electrification similar to the curve in Fig. 21. These emphasize the results already discussed. These curves come nearer and nearer together at high temperatures as absorption is eliminated, and apparently would coincide at some temperature between 40° C. and 50° C., the limiting temperature the condenser could stand.

The experiments given above would indicate that in the case of the paraffin condenser, absorption will never be eliminated until the capacity becomes infinite. The temperature was raised until the resistance became only $\frac{1}{20}$ of its normal value. The absorption, though diminishing, was very definite in amount, and the condenser would evidently break down before the residual discharges entirely cease.

CONCLUSION.

The action of a condenser is dependent, in a marked degree, upon its previous history; so much so, in fact, that its previous charges may be of more importance in determining its action under certain circumstances than charges received later. In that case the previous absorption, after neutralizing the absorption due to the final charge, may give rise to residual discharges which increase with time up to their previous initial value.

Absorption gives rise to the phenomena of residual charges and causes the condenser to depart from the exponential law in discharging through its own dielectric. The increase in apparent resistance in the condenser during discharge is associated with this effect of absorption. Previous charges modify these results, increasing or decreasing them according to whether the previous charges were in the same or opposite sense.

The resistance of pure oils is constant at any one temperature, but falls off rapidly with the temperature. There are, accordingly, no absorption or residual effects in pure oils.

In solid dielectrics the effects of absorption are diminished as the temperature is increased, as shown by the residual discharges and by the changes in the insulation resistance.

This investigation can in no wise be considered as comprehensive. Many of the results here described are already known, but they have not before been presented together so as to show the relation between them. The fact that the previous condition of the condenser has such an influence upon its action causes considerable embarrassment in an investigation of this sort, inasmuch as a condenser used once under certain conditions may be practically useless in the same investigation for further experiments. One of the condensers experimented upon retained its past charges after being short-circuited for a month, and it was necessary to employ another condenser, which was neutral, for further experiments.

1. This word as here used may be misleading. It is used to denote the time the condenser stands electrified after being separated from the source of potential.

2. Bedell, Ballantyne and Williamson, "Alternate Current Condensers and Dielectric Hysteresis," *Physical Review*, vol. 1, No 2

## Metropolitan Elevated Electric Railway.

After some delay, work on the power house of the Metropolitan West Side Elevated Railroad company is being pushed as rapidly as possible. The machinery foundations are all in, and the building walls are now going up. The station is on the line of the road between Throop and Loomis streets and fronting on the alley between Van Buren and Congress streets. When completed and equipped it will rank with the largest electric power houses in the country. The power house is immediately in the rear of the old Throop street municipal electric lighting station, which was purchased from the city by the railway company for the right-of-way and which is still standing. The contract for the electrical equipment of the Metropolitan road was awarded to the General Electric company on June 22d, and the field castings for one of the 800 kilowatt ten-pole generators are already on the ground. The boilers, from the Babcock & Wilcox company, have been delivered, and it is believed that there will be no difficulty in securing all the machinery of the plant as fast as the building is made ready for installation. It is now thought that the first train over the line will not be run before the latter part of December or the first of January.

1. See preceding note.

## Alternating Current Motors.[1]

By L. M. Pinolet.

The alternating current system possesses many advantages for the transmission and distribution of electrical energy, but until recently has labored under the disadvantage that it could only be employed for lighting, except in a few special cases, as there were no alternating current motors suitable for general use. This drawback has now been overcome, and self-starting alternating current motors of simple construction and high efficiency can be had. As the alternating current system is so extensively used and is so suitable for the long-distance transmission of power, these motors have attracted much attention, and it is my intention to explain briefly in this paper the principles of construction and operation of some of the most important types of the motors.

It has been known for a long time that an alternating current dynamo of the ordinary single-phase type would run efficiently as a synchronous motor if its armature were supplied with an alternating current and its fields were magnetized by a continuous current. To illustrate the operation of this type of motor, let us take a four-pole motor whose armature windings are connected with a source of alternating current, and are arranged to produce four poles to correspond with the four poles of the field, two of which are north poles and two south poles. The strength of the magnetic field necessarily varies uniformly in all the armature poles. If at a particular instant one of the poles be a north pole, the two adjacent ones at right angles to it are south poles. At the next alternation of the exciting current, the first named pole will be a south pole, and the two at right angles to it will be north poles, and so on, the poles will change for successive alternations of the current. It is thus apparent that the action of the alternating poles of the armature upon the poles of the other element of the motor is at one alternation of the current in a certain direction and at the next alternation is in the opposite direction. The attraction at one alternation is thus neutralized by a repulsion at the succeeding alternation, and consequently the motor will not move. But, if the movable element be rotated in either direction at a synchronous speed with the shifting of the magnetic poles of the armature, the armature poles can be brought into such a position with respect to the field poles that the attractions and repulsions between them are always in the direction in which the motor is running. The motor will then continue to run at a synchronous speed and will stand a considerable overload without being thrown out of step or synchronism. A synchronous motor is usually brought up to speed by a small non-synchronous motor of one of the types described below. When the large synchronous motor is running at the proper speed, it is connected with the line by a switch and the load is thrown on by a friction clutch.

The difficulty of starting these synchronous motors has rendered them unsuitable for general use, and a number of electricians have worked at the problem of making a self-starting motor for single-phase alternating currents.

One of the methods adopted is to provide one of the elements of the motor with two energizing circuits which produce separate sets of poles in the element. The alternating currents in the energizing circuits are caused to differ in phase and thus set up a rotary magnetic field in the element as in a two-phase motor. The rotary field induces currents in closed circuit windings on the other element of the motor, which currents cause the motor to run by their action on the rotary field. The difference of phase between the currents in the two energizing circuits can be obtained in one of the following ways.

Both circuits are connected to the same source of alternating current, but the circuits have different coefficients of self-induction, so that the current in one circuit lags behind that in the other. The difference in the self-induction of the two circuits may be obtained by inserting a condenser in one circuit and a self-induction in the other.

One only of the circuits is connected with the source of alternating current. The other circuit is closed on itself, and is within the inductive influence of the first circuit. The alternating currents in the first circuit induce currents in the closed circuit, which differ in phase from the inducing currents.

In another type of single current motors the rotary element is provided with normally open circuit coils, whose terminals are connected to a commutator, and the field of the stationary element is excited by an alternating current. By means of brushes the circuits of the coils are closed when they are in such a position that the magnetic field of the currents induced in the coils by the exciting magnetic field is assymmetrical with respect to the exciting field. The field of the induced currents is repelled by the exciting field, and thus the movable element of the motor is caused to rotate.

If the movable element of a motor of the above described type be provided with a number of closed circuits, the field of the currents induced in the closed circuits will be symmetrical with the exciting field when the motor is at rest. The repulsions will then be equally strong in both directions, so that the motor will not rotate. But, if the movable element be rotated in either direction, the fields become assymmetrical with respect to each other, and the repulsions are greatest in the direction in which the movable element is rotating, so that it will keep on rotating when started, with a tendency to synchronism. These motors can be started by an extra energizing winding, used only at starting, in which the current is caused to differ in phase from that in the regular energizing circuit by one of the above described methods. Or the motors can be started without a starting winding if the circuits of the coils of the rotary element are open and are connected to a commutator. The motor is started in the way already described by closing by suitable brushes the circuits of the coils when they are in such a position that their magnetic field is assymmetrical with respect to the exciting field, and, when the motor has acquired its proper speed, the circuits of all the coils are closed. Prof. Elihu Thomson, who has done much to develop

1. Read before the Canadian Electrical association, Montreal, September 19, 1894.

motors of this type, says in a recent article that they have attained a fair degree of perfection, although the writer of this paper is not aware that any reliable tests of their efficiency have been published.

Having examined the principal types of single current motors, we will consider the polyphase motors, which are self-starting and of an extremely simple construction.

A polyphase motor consists essentially of a rotary and a fixed element, each provided with suitable windings. The windings of one of the elements are supplied with polyphase currents, which consist of two or more separate alternating currents having the same frequencies, but whose phases differ from each other. These currents set up a magnetic field in the element, which field is rotated, or progressively shifted, around the element, by the combined action of the different currents. The rotating field attracts the field produced by currents in the windings of the other element and thus causes the movable element of the motor to rotate. This principle, upon which a polyphase motor operates, is analagous to that of a continuous current motor, for the commutator of a continuous current motor produces a rotation or progressive shifting of the magnetic field of its armature. The attraction between the rotary field of the armature and the stationary field of the field magnets causes the armature to rotate.

In this paper, in order to avoid the confusion at present existing as to which element of a polyphase motor is the armature and which is the field, the element in which the rotary magnetic field is produced is called the armature and the other element is called the field.

To illustrate the working of polyphase motors, we will take as an example a two-phase motor with a stationary armature provided with two sets of windings. The two windings are supplied with separate alternating currents and produce two pairs of poles at right angles to each other. The two alternating currents have the same frequencies, but one of them lags behind the other by 90 degrees, and, therefore, the magnetic field of one pair of poles is at its maximum strength when the field of the other pair is at zero, or is neutral. If at any instant a particular pole of the four poles be a north pole, one of the poles at right angles thereto will subsequently become, at the next instant, a north pole. Then, the opposite pole to that first named will be a north pole, and, at succeeding alternations of the exciting currents, the north pole and necessarily the south pole as well, will be rotated, or progressively shifted, around the armature in a certain direction. In this way a rotary magnetic field is produced in the armature.

Instead of an armature of this type, the armature may be an ordinary Gramme ring armature, but without a commutator, and the two currents may be supplied to the windings at points 90 degrees apart (points 180 degrees apart being connected with the same circuit). The combined action of the two currents will set up a rotating magnetic field in the armature, similar to that produced in the armature of a continuous current motor when running.

If a pivoted copper cylinder be placed inside an armature of either of the above types in which there is a rotating magnetic field, the rotation of the field will induce currents in the cylinder, which, according to Lenz's law will be in such a direction as to oppose the movement of the field. This opposition to the rotation of the field will cause the cylinder to rotate. As a copper cylinder would be unsuitable for use as the field of a motor, this element is usually composed of a cylinder of laminated iron mounted on a shaft. The cylinder is provided with copper windings parallel to its axis, which are connected together in a number of closed circuits. The rotary field induces currents in these closed circuits, which oppose the rotation of the field, and these currents thus cause the motor to rotate.

The currents induced in the closed circuits are proportional to the number of lines of force of the rotary magnetic field, which cut them in a given time. The number of lines cut is greatest when the motor is at rest, and becomes less as the speed of the motor increases, until synchronous speed is reached, when no lines cut the closed circuits. For example, if the exciting currents have a frequency of 60 periods a second, when the rotary element of the motor is stationary the closed circuits are cut 60 times by a north field and 60 times by a south field each second. When the rotary element has a speed of 40 revolutions a second, the closed circuits are cut 20 times by a north field and 20 times by a south field each second. The number of lines cut thus varies directly as the difference between the speed of the rotary element of the motor and that of the rotary magnetic field, and, when there is no difference in speed, no lines are cut and no currents are induced in the closed circuits. With no currents in the closed circuits, there is no magnetic field to act upon the rotary magnetic field. The motor, therefore, runs at a speed which is less than that of the rotary magnetic field, the difference between the two speeds being called the magnetic slip. The closed circuits have a very small resistance, so that strong currents are induced in them by the cutting of a comparatively small number of lines of force, and the magnetic slip is therefore small. Anyone can easily satisfy himself that the currents induced when the magnetic slip is small will produce a strong torque by exciting the field of a continuous current dynamo or motor and short-circuiting the brushes. On turning the armature by hand, the torque will be found to be considerable.

In practice, the variation in speed of a motor of this type between no load and full load is generally from 3 per cent. to 5 per cent. From the foregoing explanations it is evident that, if the field of the motor be excited by a continuous current, it will rotate synchronously with the rotary field. Synchronous polyphase motors are constructed on this principle and keep in step with the alternations of the exciting alternating currents even if heavily overloaded. They are self-starting, but do not start readily, and for this reason are not capable of such extensive use as the non-synchronous motors, though they have been found to be preferable for large units. We will therefore confine our attention to the non-synchronous motors.

When a non-synchronous motor is running at full speed the alternations of magnetism in the field are few, as already explained, and the hysteresis losses in the iron are correspondingly small, but in the armature the alternations of magnetism and the hysteresis losses remain the same as when the motor is stationary. As the rotary element of the motor contains considerably less iron than the stationary element, the hysteresis losses are decreased and the efficiency of the motor increased by having a rotary armature and a stationary field, so that the most frequent changes of magnetism will take place in the element which has the least iron. But in small motors, and also in large motors where a slight decrease in the efficiency is not of importance, the armature is preferably stationary and the field is rotary, as this arrangement dispenses with collectors and brushes.

The field of a non-synchronous polyphase motor is usually the rotary element of the motor, for then brushes and collectors are not required, as already explained. The field then consists of a laminated iron cylinder mounted on a shaft. A number of stout copper wires or bars are threaded through holes near the periphery of the cylinder and parallel to its axis, or are imbedded in slots in the cylinder. By this construction the air gap between the iron of the field and that of the other element of the motor can be made very small, which is essential to efficiency, for, if the magnetic resistance of the air gap be not comparatively low, a large magnetizing current will be required by the motor. The bars or wires are carefully insulated from the cylinder and are connected together at each end to a copper ring, which joins them together in a common closed circuit, or they are connected together in a number of independent closed circuits. When the field is stationary it usually consists of a cylinder or ring of laminated iron, in the center of which is the rotating armature. The windings of the field are arranged and connected together in the same way as when it is rotary, with the exception that the windings are on the inner periphery of the cylinder or ring.

The armature of a polyphase motor is preferably a ring or cylinder of laminated iron somewhat similar to the field core. For, as is apparent from the manner in which the magnetic field rotates around the armature, a ring of iron without projecting pole pieces facilitates the rotation of the field and also avoids injurious reactions caused by the projecting pole pieces. One of the simplest forms of this type of armature is the Gramme ring armature already referred to, which has no commutator and whose windings are supplied with two-phase currents at points 90 degrees apart, points 180 degrees apart being supplied by the same current. The combined action of the two currents sets up a single rotary magnetic field in the armature. The same result is obtained with three-phase currents by supplying the currents to the armature windings at points 120 degrees apart. The drum winding is, however, generally used instead of the Gramme winding, and in this case the windings are connected together by conductors arranged around the ring near its periphery. The windings of this type of armature are imbedded in the iron core in the same way as those of the field, and for the same reason, viz., to reduce the magnetic resistance of the air gap. A ring armature of this type can serve as either the stationary or rotary element of the motor. When it serves as the rotary element, the currents are supplied by collectors and brushes.

The armature windings are arranged to produce a greater or less number of poles according to the speed at which the motor is desired to run. The speed varies directly as the frequency of the exciting currents and inversely as the number of pairs of poles in the armature. For example, if a motor having two pairs of poles be supplied with four pairs, the rotary magnetic field will then take twice as long as at first to make one revolution, and the speed of the motor will be reduced correspondingly, as it is governed by that of the rotary field. The same result can be accomplished without diminishing the number of poles, by reducing the frequency of the exciting current one-half, which reduces the speed of the rotary field so that it takes twice as long as at first to make one revolution. A motor, therefore, must be adapted to the frequency of the current on which it is to be used, and in order to have a slow-speed motor without many poles the frequency must be low. When the speed desired in the motor requires many poles in its field and armature a stationary armature without projecting poles (similar to the field magnet of a continuous current multipolar dynamo) is generally used instead of the ring type of armature, as it is difficult to get many poles in an armature of the latter type.

The foregoing explanations show that polyphase motors are of an extremely simple construction, consisting only of a rotary and a stationary element of laminated iron with suitable windings, and usually without sliding contacts or brushes. They possess a number of good qualities, among which the most important is probably the absence of a commutator, which must be used with continuous current motors, and which requires much attention and is the source of much trouble. The absence of a commutator practically limits the care and attention required by a polyphase motor to oiling the bearings.

The simplicity of construction ensures freedom from repairs as well as facilitates the insulation of the various windings. The closed circuit windings on the field are never subject to an electromotive force of more than a few volts, so that the insulation is not likely to break down. The motors will stand a considerable overload without undue heating, and will also stand considerable abuse without damage. Regarding this point, Dr. Louis Bell, in a recent paper before the American Institute of Electrical Engineers, stated that he had never been able to burn out an armature coil or to seriously injure a polyphase motor by the severest tests.

The non-synchronous motors start with a strong torque and run almost at a constant speed under large variations of load, and compare favorably in these respects with continuous current motors. Tests of polyphase motors of different sizes show that their efficiencies are equal to those of continuous current motors of the same sizes.

It is no wonder that the two-phase and three-phase systems for the transmission and distribution of electrical energy are attracting so much attention when the good qualities of the motors are taken into consideration in conjunction with the fact that by these systems alternating currents can be furnished for light and power, and in addition continuous currents can be supplied by means of rotary transformers. The polyphase system is thus capable of universal application, as from it can be operated any kind of electrical apparatus for either alternating or continuous current and at any voltage.

## Convention of the Ohio State Tramway Association.

On September 26th the annual meeting of the Ohio State Tramway association was held at the Boody House, Toledo. President Albion E. Lang of the Consolidated Street Railroad company of Toledo made an address in which he extended a hearty welcome to the visitors. Among those present were Albion E. Lang, Consolidated Street Railroad company, Toledo; James Robison, Toledo Street Railroad company, Toledo; J. K. Newcomer, Delaware Electric Railroad company, Delaware, O.; R. Carpenter, Mansfield Street Railroad company, Mansfield, O.; B. P. Foster, Toledo & Maumee Valley Railroad company; W. F. Kelley, Columbus Street Railroad company, Columbus, O.; W. S. Jewell, Consolidated Street Railroad company, Toledo; J. B. Hanna, Cleveland City Railroad company; W. G. Owens, Des Moines Street Railroad company, Des Moines, Ia.; C. M. Fuller of the Davis Car Shade company; H. H. Foster, the Dreher Manufacturing company, New York; John Dale of the Dale Manufacturing company; E. A. Smith, Consolidated Car Heating company. The topics discussed at the meeting were: First, "The Best Method of Collecting Fares;" second, "A Desirable and Satisfactory Fender;" third, "What Are the Best Qualifications for Car and Motor Men?" fourth, "The Treatment of Low Joints in Rails and How to Prevent Them." Entertainment was provided by the local representatives, including several little excursions and a banquet at the Toledo club.

## Converter Litigation.

The Westinghouse Electric & Manufacturing company, through its attorneys, Kerr & Curtis, has instituted a suit in the United States Circuit Court, New York, against the General Electric company for an injunction and damages on account of an alleged violation by the defendant company of a patent used in electrical converters, granted in 1887 to Oliver B. Shallenberger and subsequently purchased by the Westinghouse Electric company. The complaint charges that the patent is one of great value and that the Westinghouse company is sustaining heavy losses by the unlicensed use of the converters by the General Electric company. The court is asked to appoint a referee to compute the profits made by the General Electric company and the damage done to the complainants, and an injunction is asked for to prevent the continued violation of the patent.

## Sweet Automatic Limit Switch.

It is a fact admitted by all practical electricians that a fuse is only a frail protection, available only as a last resort to protect a station when all the damage is done that possibly can occur outside the main point of distribution. If the safe carrying capacity which is required to develop the work of a station's service is exceeded, there is not only a waste of energy but also an excessive strain on whatever is in circuit if not checked on its immediate approach. As at present, with the fuse as a protection, if short-circuits occur, whether it is in a lamp circuit, in an armature field or on the lines, or in the segments of a commutator, it means an increase of current. A station can operate under these conditions without any knowledge of the fact until the result is shown by a sudden check, when the motors or current refuse to operate or the circuit burns out. This condition is known too late for remedy. If it is an armature or a field which burns out, it blows a fuse.

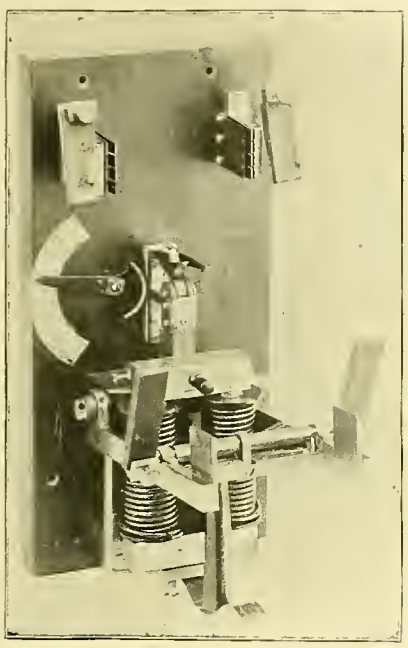
With the Sweet limit switch, which is shown in the accompanying illustration, the circuit being open, every dynamo, motor, lamp circuit, or whatever service it is in connection with, is entirely independent, for the reason that it is adjustable to one one-hundredth of an ampere and the current cannot exceed the amount to which the switch is adjusted without opening the circuit. The switch is equally invaluable in connection with all other electrical apparatus, as it is a positive protection against an over-load or over-production of current. As a protection against fires, caused by short-circuits by wires coming in contact in buildings, it automatically opens the circuit, cutting off all current from entering the building, on the immediate approach of any and all defects which produce an excess of current. For telephone, telegraph and fire alarm systems its value is readily apparent.

This device is constructed upon sound electrical and mechanical principles. It has two coils from which the armature bar swings above on centers, and the locking and opening of the instrument is attached to a fiber suspension directly attached to the armature, with a steel roller which follows over a steel plate formed in such shape that when the armature begins to move the force of the suspended arm is increasing rapidly, and the unlocking of the lever

takes place with this force: and as soon as unlocked, the rotating carboos, with their outward pressure (which is given them by springs attached), makes the opening of the instrument positive in every detail. Particular attention is called to the fact that the breaking of the current is between carbons, in such a manner that when the metal contact is broken the contact is made on carboos, which are rotating, throwing in to a resistance which, before breaking the final point of contact, greatly reduces the volume, and then is broken, leaving no possible chance to carbonize the air, as the motion is very rapid.

The adjustment of the instrument is made by the lever attached to a cam, adjusting the armatures to that of the field pieces, which is controlled inversely as the square of the distance of the armature in the instrument to that of the field pieces, so that mechanically the pull or work the instrument has to do to open the circuit is practically constant, whether in one ampere or five hundred amperes, any further than one ampere has less distance to pull the armature than for five hundred amperes—a principle that is true and positive, so positive and delicate in its adjustment that in the larger sizes—200 to 1,000 amperes capacity—the device will open on one-fourth of an ampere over and above its set capacity, and in the smaller sizes—one-half to 200 amperes—in less than one-twentieth of an ampere.

The switch is designed to be used in central stations or isolated plants, in connection with dynamos, motors, in



SWEET AUTOMATIC LIMIT SWITCH.

house wiring, and in general in all cases in place of fuse wire, and may be used on alternating work.

The Sweet Electric & Manufacturing company, Grand Rapids, Mich., which manufactures this switch, has another switch which is especially adapted to street car work. This device is just as delicate as those for other work, but the jolting of the car will not affect it, while one-tenth of an ampere over the limit will open the circuit. The instrument is mounted on a solid marble base and connections are made on the back side. Its mechanical construction makes it very neat and attractive in apppearance.

## The Trolley in Brooklyn.

The *New York Tribune*, discussing the trolley lines in Brooklyn, published the following interesting summary last week: "The history of the trolley in Brooklyn dates from yesterday. Last year the Brooklyn City railroad alone carried 83,000,000 passengers, while the Brooklyn elevated road carried in the same time only 38,000,000. The Atlantic avenue line carried 16,000,000 passengers, while the Kings County elevated road carried only 18,000,000. The Brooklyn City & Newtown road carried 12,000,000, the Broadway 9,000,000, and the Brooklyn Heights 8,000,000. These are the principal surface and elevated lines in the city. Permission was first given for the use of this system by the Common Council January 11, 1892, the State Board of Railway Commissioners having taken action in the matter previously in November, 1890. The first trolley car that was actually run started on May 22, 1891, on the Second avenue line of the Brooklyn City railroad. The Brooklyn & Coney Island line (Smith street) ran its first through car to the ferry September 14, 1892. The Hamilton avenue line began June 1, 1892, and another section on November 7th the same year, Court street, December 26, 1892; Fulton street, June 7, 1893; Flatbush avenue, March 13, 1893; Gates avenue, June 23, 1893; Putnam avenue, July 17, 1893; Greenpoint, September 2, 1893; Flushing, October 1, 1893, and Third avenue and DeKalb avenue in November, 1892. The power stations of the Brooklyn City railroad are at Fifty-second street and First avenue, and Kent and Division avenues. The Brooklyn & Coney Island road has a station at Smith and Ninth streets, and one also at Kings Highway and Coney Island avenue. The DeKalb avenue station is at DeKalb and Central avenues, and the Atlantic avenue, at Gowanus Canal and Second street. One of the tallest chimneys in the country has been built in connection with the Kent avenue house. It is 302½ feet in height, and 38 feet square at the base, and there were used in its construction 2,500,000 bricks. The Brooklyn City line has 125 miles of span wires, 144 miles of guard wires, 177 miles of trolley wires, 195 miles of supplementary ground wires, and 15,397 miles of feeders, which are composed of small wires. This gives a total of 16,397 miles of wire."

## Universal Telephone Switch Hook.

The accompanying cut represents an improved telephone switch invented by E. C. Bradley of Rochester, N. Y., who seems to have solved in a practical manner the problem of supporting the telephone on its hook and making the necessary connection without infringing any of the existing telephone switch patents. The device is applicable for operating all styles of receivers and transmitters, and is made in two styles—one intended to be placed into the side of the call box or transmitter and the other, the rim style, which can be fitted without mortising. The reasons advanced to substantiate the claim that this switch hook is non-infringing are the following: It is not automatic; it does not operate in either direction by the act alone of removing from or placing of the receiver in position, the receiver actually having nothing to do with the operation of the device, as one can accomplish the necessary electrical connections without being obliged to use the receiver, the switching being done by a compulsory hand movement; it accomplishes the necessary electric connection before the receiver can be removed from or placed in position. The Universal telephone switch hook is placed upon the market by E. C. Bradley & Co. of Rochester, N. Y.

## Litigation Over Electric Fixtures.

In the United States Court of Appeals at Philadelphia, September 26th, Judges Acheson, Butler and Wales heard arguments in the suit of George Maitland against Alfred C. Gibson, trading as the Gibson Gas Fixture Works, for alleged infringement on the complainant's patented improvments in gas and electric light fixtures combined. The case was an appeal of Mr. Maitland from the decision of Judge Dallas, in the Circuit Court, under which it was held that no infringement had been made, and the bill of complaint was dismissed. Attorneys D. H. Driscoll and R. N. Dyer of New York appeared for Mr. Maitland, and Hector T. Fenton for the Gibson works. Decision was reserved.

## Electric Circuit of St. Louis.

At the regular monthly meeting of the Electric Circuit of St. Louis, September on 27th in the club rooms, Eleventh and Locust streets, the subject of electrical calculations as performed on the slide rule was discussed by Charles Briner. The subject proved exceedingly interesting to the members present, and considerable interest was shown in Mr. Briner's method of electrical calculations. This was followed by a general discussion of electric motors, which was partici pated in by several members.

## Assignment of Taylor, Dee & Mack.

Last Monday the firm of Taylor, Dee & Mack, 348 Dearborn street, Chicago, manufacturers and dealers in electrical machinery and material, made an assignment for the benefit of creditors. F. S. Terry of Chicago was made assignee, and a statement will soon be made of the affairs of the concern. It is reported that the principal cause for the assignment at this time is the fact that internal dissatisfaction existed among the members of the firm and that if the creditors so desire a reorganization may be effected and the business continued. An inventory of the stock is now being taken, and Assignee Terry expects to be in a position to make a report in a few days.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, October 1.—Motorman Michael Lewis of the Newark & South Orange trolley road, who was convicted of manslaughter by the Court of Special Sessions at Newark, N. J., on September 22d, received a sentence of one year in the county penitentiary last Monday. Judge Kirkpatrick, who sentenced him, lectured Lewis severely for his carelessness, and said that he felt that it was his duty to make an example of him, as there was too much carelessness upon the part of motormen in Newark. Lewis expected a fine, and had hopes that the company would help him.

The Board of Bridge Trustees has decided to light the Brooklyn bridge cars with electricity. The change in the system will be completed in December.

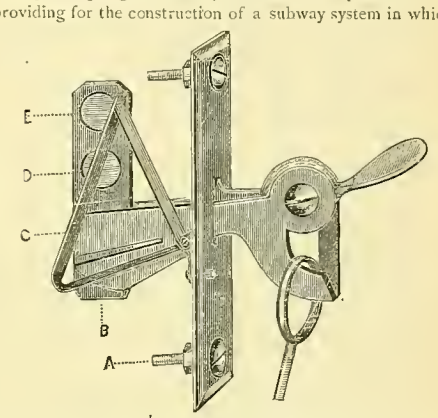
It is rumored that the Bell Telephone company may remove its headquarters to New York. There was incorporated at Albany last week the Standard Telegraph & Telephone company, with a nominal capital stock of $50,000, and the list of incorporators contains names of men interested in companies subordinate to the Bell company. A director of the new company says that the Bell patents will be used by agreement. It is hinted that the new company will build the Western lines which the Bell company proposed to build with its $30,000,000 new capital, and that the two companies will then be consolidated, with offices here.

The rapid transit commissioners have taken action to have the question of building a road with city money submitted to the popular vote at the coming election in accordance with the act passed by the last Legislature. There will be two ballots: "For municipal construction of a rapid transit road," and "Against municipal construction of a rapid transit road." If the vote should be in favor of the former the commissioners will be required to proceed within thirty days after the declaration of the result "to construct the said railway or railways, and to make and let all contracts required for the performance of the work." The commissioners have already adopted the underground plan prepared by the old commission, but it is understood that they have power to make such changes in it after the election as may seem advisable. If the vote is against municipal construction, the plan of building a road with city money must be abandoned, and it will then become the duty of the commissioners to adopt a system to be built by private capital.

W. F. O.

## St. Louis, Mo.

ST. LOUIS, September 29.—It will be remembered that during last spring the Subway Commission reported a bill providing for the construction of a subway system in which




UNIVERSAL TELEPHONE SWITCH HOOK.

all companies using wires could place their wires. This move on the part of the city caused the companies to bestir themselves in the underground matter. The Western Union Telegraph company brought a bill before the Municipal Assembly asking for an underground privilege. The Missouri Electric Light & Power company made application to the Board of Public Improvements for a similar privilege. The summer vacation of the assembly has prevented any action on either of these underground schemes. The Postal Telegraph-cable company entered into an agreement with the St. Louis Underground Service company to place its wires in the subway of that company, and has now placed the greater part of its wires underground, and the remainder will go underground as soon as the Underground Service company can provide the necessary subways. And now comes the Laclede Gas Light company, not asking for any franchise, but claiming that under an old state charter it has the right to put its wires underground without a franchise from the city. The state charter was granted in 1857, and section 5 provides that the company "is authorized to light a certain district of the city, to make and vend gas, gas lights and fixtures, and any substance or material that may be now or hereafter used as a substitute thereof and to that end may establish and lay down all pipes, fixtures and other things properly required to do the same." It is claimed that the words "other things" covers electricity, although when the charter was drawn in 1857 electric lighting was entirely unknown. Charles Gibson, who drew up the charter, states, however, that he had heard of the experiments in electric lighting in Europe at that early date and framed the charter so as to cover the possible use of any substance other than gas. This charter was granted for a period of 30 years and in 1868 a perpetual extension of the charter was granted by the state Legislature, but it is claimed that a new state constitution adopted in 1865 prohibited the Legislature from granting such charters. If this claim shall stand good in law, that is, if the Legislature has no authority under the new state constitution of 1865 to grant an extension of the Laclede charter beyond the original 30 year period, the

Laclede Gas company's charter expired in 1887 and it has been without a charter since that time. On the other hand, if the charter is valid, the perpetual extension of the charter is equivalent to granting a new charter to take effect on the expiration of the old one and is therefore equivalent to a new charter. But aside from this there is the present state constitution, which was adopted in 1875, which gives to every municipality the right to govern its own thoroughfares, and this right has always been sustained by the courts. The action of the Laclede Gas company so far consists of a resolution ordering that its wires be placed underground on Broadway between the Mullanphy street station and Olive street, simply as an experiment in underground service, but is really an experiment to find out what attitude the city will take in the matter.

E. T. Farish, referee in the suit of the St. Louis Electric Light & Power company against the Edison General Electric company for commissions amounting to some $83,000 on the sale of Sprague railway apparatus, has filed his report. A counter claim by the defendant for $14,609 for apparatus sold to the plaintiff was admitted by the plaintiff and credited to the defendant. The suit was resisted on two grounds: First, that an accounting had been rendered and that the plaintiff had been paid in full; second, that the plaintiff had agreed to handle no other apparatus than Sprague and that the plaintiff had broken the contract by selling other motors than Sprague. The referee found against the defendant on all points and gives to the plaintiff $39,771.85, from which is deducted a counter claim of $14,609 and a stipulated item of $1,265, leaving a net judgment of $23,897 in favor of the St. Louis Electric Light & Power company. The plaintiff filed exceptions to the report of the referee, in which he cut down the commission from 15 per cent. to 7½ per cent. The defendants also filed exceptions generally to the referee's report. R. J. H.

## Northwestern Notations.

MINNEAPOLIS, September 29.—The Minneapolis General Electric company is about to build a new power station to succeed the two it now has. The new station will be as isolated as possible to avoid danger from fire and will be located at the foot of Third avenue Southeast, on the east bank of the river. The building will be of brick and stone, two stories high, with interior dimensions of 100 by 151 feet. A boiler house adjoining will be one story high and 60 by 151 feet. The dynamo room will be fifty feet wide and run the full length of the building. It will have 35 dynamos for arc, and incandescent circuits. The new location will combine water and steam for motive power. The water power will come from three 800 horse power horizontal turbine wheels, and the steam from engines of 3,500 horse power. Work will begin at once, and it is hoped to have the plant ready by January 1st. The feed wires will enter the underground conduit system at the abutments of the steel arch bridge across the east channel, and all overhead wires will be taken down in the subway district. The estimated cost is $200,000 or more.

Messrs. Earle and Fargo have been canvassing Grand Rapids, Minn., for subscribers to a telephone exchange and have secured enough to warrant a system. Wires will be strung at once, it is said.

The Carter Car Brake company was recently organized in Minneapolis and is actively pushing its patent car brake. The brake has been in active service on two electric cars on the local system and has worked so satisfactorily as to gain strong recommendation from the vice-president of the Twin City Rapid Transit company and the master mechanic of the company. It is claimed that this brake requires manual effort multiplied about 15 times as compared with the average brake's 60 times, the wheels of the car furnishing the rest of the power. This reduces the amount of slack chain to a minimum and enables a stop in less than two-thirds the distance formerly required. The brake will be exhibited at the national conference of street railway managers to be held in Atlanta, Ga., October 18th. A manufacturing company will be organized either in Minneapolis or Chicago.

Ex-Mayor W. Z. Haight, E. E. Crandall and C. Canfield have formed an association to put in a telephone system in Winnebago City, Minn.

Promoters of an electric railway to run between Sioux City, Ia., and Dakota City, Neb., are pushing their project enthusiastically. Dakota City and South Sioux City may be asked to vote a tax in aid of the plan. The company contemplates crossing the Missouri river on a pontoon bridge.

The Cedar Rapids, Ia., Electric Light company is stringing its wires for street lighting and has just received its new engine for power, which will be placed in position at once.

The Harrison International Telephone company of Chicago has been canvassing Menomonie, Wis. If it can get 300 subscribers it will put in a plant. The company has secured 268 and will doubless get the remainder. It offers a reduction of $12 from the Bell company's rates, and there is likelihood of a telephone war in Menomonie.

The Butte Electric Light company of Butte, Mont., has brought suit against William Owsley for $20,000 for breach of contract. A five-year contract was made September 4, 1891, by which it agreed to furnish light for the Owsley building. The contract was carried out until March 1, 1892, when Mr. Owsley disconnected the wires and refused to allow the company to furnish more light. The company claims that it expended $7,500 for machinery and in preparation for the contract, and the machinery is now useless and worthless owing to the action of the defendant. It also claims damages for $12,500 owing to the failure of the defendant to carry out his contract.

The council of Albert Lea, Minn., is considering propositions from the Siemens & Halske Electric company of America and the Electrical Engineering company of Minneapolis to put in a lighting system.

Samuel Grant of the Security bank of Faribault, Minn., is president of a company which proposes to put in a telephone system there.

Braun & Kaubasch of Olivia, Minn., will put in a plant to light the city in connection with their flour mill.

James Sheridan has the contract for lighting two fire stations in La Crosse, Wis., at $398.50.

The Northwestern Gas & Electric company has been organized at Washington, Ia., with an authorized capital stock of $250,000.

Dunlap, Ia., proposes to put in electric lights.

The proposition to grant an electric light franchise to E. B. Hillman & Co., at Lake City, Ia., has been carried, and work on the plant will be begun at once.

The council of Albert Lea, Minn., has decided to advertise for bids to furnish an electric lighting plant, to be put in operation this fall.

A. J. Hayward of Tacoma, Wash., proposes to build a 30 foot dam across the Nisqually river to furnish power to light the city with electricity. The place proposed for the dam is about 22 miles from the city, and Mr. Hayward owns the water rights on the river, which gives him the right to dam the river for power purposes. City officials are inspecting the ground and considering the plan. It would involve the expenditure of about $75,000

The Minneapolis Board of Trade is agitating the matter of getting electric lines from Fort Snelling and St. Anthony Park direct to the business center. There are lines running from these suburban points into St. Paul, and Minneapolis business men think they ought to have this trade, or a part of it. President Lowry says that the Twin City company cannot afford to build and operate such lines. He is emphatic in his statement that no new lines will be put in for some time.

The Twin City Rapid Transit company has been fighting the St. Paul aldermen over the pavement of business streets with asphalt. The company wanted something else between the tracks, but failed to carry its point. Hennepin avenue in Minneapolis is also being paved with asphalt.

Commencing October 1st, the street railway company resumes the giving of transfers to and from the interurban line, the same as in St. Paul. This has been a bone of constant contention ever since the transfers were abolished. N. L P.

## PERSONAL.

Joseph E. Lockwood, president of the Michigan Electric company, Detroit, was in Chicago last week.

Paul W. Bossart, manager of the United Electric corporation, Minneapolis, Minn., was in Chicago last week.

O. W. Meysenberg, president of the Siemens & Halske Electric company of America, was in New York last week.

Chester D. Crandall, general manager of the Western Electric company, spent a few days in Rochester, N. Y., last week as the guest of George J. Kaelber.

William M. Porter, formerly of the Fort Wayne Electric corporation, has become associated with Pierce & Richardson, Manhattan building, Chicago, in the interests of the chloride accumulator.

General Sales Agent F. S. De Ronde of the Standard Paint company is receiving the congratulations of his many friends upon the announcement of his engagement to Miss Kate Weaver of Englewood, N. J. The wedding is announced for October 11th.

G. Tracy Rogers of Binghamton, who was elected president of the New York State Street Railway association at the last convention, received a very flattering notice in the *Binghamton Message* of September 23d. Mr. Rogers has done much to build up the city of Binghamton, and his fellow citizens recognize and admire his ability and the public spirit he has displayed.

President Cleveland has appointed General William Ward Duffield of Detroit superintendent of the Coast and Geodetic Survey, to succeed Professor T. C. Mendenhall, resigned. General Duffield has a distinguished record in civil and military life. He is one of the best known civil engineers in the United States, and has been concerned in the building of many railroads and the surveys of public lands. He served in both the Mexican and Civil wars, and reached the rank of brevet major-general.

## NEW INCORPORATIONS.

Magnetic Telephone company, Oak Park, Ill.; capital stock, $100,000; Henry E. Pocumer, Oak Park, Ill.

Westlake Electrical Manufacturing company, East St. Louis, Ill.; capital stock, $100,000; Charles T. Westlake, East St. Louis, Ill.

## ELECTRIC LIGHTING.

The plant of the Westinghouse Electric Light company in York, Pa., has been purchased by the local Edison company for $26,000.

The Ontario county fair ground, Canandaigua, N. Y., it is announced, is to be provided with electric lights, and evening races will be held.

The first central station plant in Alaska is in course of erection at Juneau. Electricity has for some time been employed in the mines of that territory, however, water power being utilized.

The Department of Public Works of Chicago has advertised for bids for the construction of a new electric light station to take the place of the station formerly on Throop street. The specifications call for a building 50 feet wide and 210 feet in length.

At a special election called for that purpose a franchise was granted to the Arkansas Valley Electric company to erect an electric light plant for Florence, Colo. The vote was almost unanimous. It is expected that work will be started upon this plant in fifteen days and that it will be running in sixty days.

Sealed bids will be received by the chairman of the light committee of the city council of Sterling, Ill., until October 15th for lighting the streets of the city by electricity. Two hundred incandescent lamps of 25 candle power each, to be suspended at street intersections or on poles at such other places as the city may direct, must be furnished with current. The terms of the contract to be for a period of 10 years from November 5, 1894; the city to have the option to increase the number of lamps at any time, at the same rate, the successful bidder to have the exclusive franchise for commercial lighting. A certified check, payable to the order of the mayor, for the sum of $300, must accompany each bid, as a guaranty that the company to whom the contract is awarded will, within 10 days, execute an acceptable bond and sign contract. John Mee, chairman of the light committee, the furnish any additional information.

## ELECTRIC RAILWAYS.

The electric railway power house at Gettysburg, Pa., has been destroyed by fire.

A complete new system of electric street railway is to be constructed at Knoxville, Tenn. Charles J. Pogue will give information.

It is reported that the Citizens' Street Railway company of St. Louis will substitute the electric for the cable system on the whole of its 13 mile route.

The Augusta, Me., Hallowell & Gardiner Electric Railroad company is considering the feasibility of an extension on the East Side of Augusta.

J. McM. Smith of South Bend, O., can give information about work to be given out on an electric railway to be constructed between South Bend and Mishawaka.

The newly opened line of electric cars at Canandaigua, N. Y., is said to be very successful. During its first week of operation 5,702 passengers were carried over the line.

D. McCartney has been granted a franchise for an electric street railway and electric light plant at Fort Howard, Wis. He promises to have all in running order by next May.

St. Augustine, Fla., is to have rapid transit in the shape of an electric road. An ordinance has been passed granting the necessary privileges and bonds to the amount of $150,000 have been issued.

The citizens of Westport, Mount Winans and vicinity, near Baltimore, Md., have formed an association with the intention of promoting an electric railway through that section. George Meeter, Westport, is president of the association.

The City Council of Catlettsburg, Ky., has granted the Ashland & Catlettsburg Electric Street Railroad company the right of way through the city on condition that it will commence building in six months and have the road completed in 12 months.

The electric railway system between Lorain and Elyria, O., covering a distance of eight miles, was opened September 15th. It is suggested that there is an excellent opportunity for an electric road between Mansfield and Ashland, O., and the agitation has already been commenced for such a road.

The West Chicago Street Railway company has received a permit from the commissioner of public works authorizing it to lay a conduit on Western avenue, between Ogden avenue and Washington boulevard, for the purpose of laying electric wires to be used in the operation of its cars by electricity.

The Chicago City Railway company's electric line from Thirty-ninth and State streets to Halsted and Sixty-ninth streets was opened on September 22d. The first train, loaded with the officials of the company and invited guests, started from State street at 8 P. M. The route is from State street west on Thirty-ninth to Wallace, south to Root, west to Halsted and thence south to Sixty-ninth street. When Sixty-ninth street was reached a crowd of several thousand people had assembled and cheered vigor-

onsly. The entire trip was made without the slightest hitch. The officers of the company claim that the line is the finest in Chicago.

The Board of Commissioners of Somerville, Pa., on September 10th granted the right of way through the main street of the town to the New York & Philadelphia Traction company by a vote of four to three. Ex-Speaker Bergen, president of the board, voted yea, thus breaking the tie and giving the company the franchise. Every concession was granted to the company, and it secures the right of way without paying a cent for it.

An electric railway between Lancaster, Pa., and Philadelphia is under consideration. Among those interested are John J. Patterson, B. F. Brenneman, W. U. Hensel of Lancaster, Hon. William B. Given of Columbia, Chief Contractor Crilley of the Lancaster Construction company, and F. W. Darlington, electrical and mechanical engineer. The officers say the contract for building the line between West Chester and Philadelphia will be awarded inside of thirty days.

A financial paper says: "The West End Street Railway company of Boston, capitalized at about $25,000,000, will close its fiscal year on September 30th, with gross earnings of $6,700,000 and net of $2,100,000, or about the same as last year. Gross earnings are increasing about $20,000 per month, and expenses have been reduced by more than $20,000 per month, so that it is believed the company will in future show a handsome surplus over dividends. More than half of its capitalization is chargeable to development under the dividend period."

Considerable encouragement is being received by the projectors of the proposed electric road in Los Angeles, Cal., to be known as the Orange Belt road. The proposition is to utilize the E street and D street horsecar lines and Waterman motor track, to make a belt through the Springs to Asylum, Highlands and other points, making a belt line of 21 miles in length. The projectors of the enterprise are now making a thorough canvass of the region through which the road will run, in order to ascertain just what assistance can be obtained.

An ambitious project is announced in the following dispatch from Columbus, O., dated September 21st: The Central Ohio Electric Railway company has been incorporated. It is a scheme for connecting Pittsburg and Chicago by electric railway. The main line will pass through Coshocton, Mount Vernon, Marion, Kenton and Celina. The company is authorized to furnish heat and light to towns on the line and is given telephone and telegraph privileges. The cost of construction will be from $10,000,000 to $20,000,000. The incorporators nearly all hail from Mount Vernon, O.

The directors of the Rochester, N. Y., & Glen Haven Railroad company—a suburban line three and one-half miles long—have determined that next season they will run their trains by electricity and abandon the steam locomotive. No change will be made until the close of this season. Although not formally decided, the location of the power house will probably be in the vicinity of the East Main street station. As the track is of the same gauge as that of the ordinary street cars it will be an easy matter when the trolley wires are put up, to run cars from any part of the city to Glen Haven.

## TELEPHONE.

The Central Union Telephone company has a force of men at work erecting poles for a telephone line connecting Sycamore, Ill., with Chicago. It is intended also to organize a local telephone exchange in the former place.

The new telephone company at Crookston, N. D., has secured a franchise from the East Grand Forks city council for the erection of a line there and will build a line connecting the towns of East Grand Forks and Crookston.

The Albany, Newton & Camilla Telephone company has been organized for the purpose of constructing a telephone line from Albany, Ga., to Newton and Camilla. T. M. Carter is president; J. M. Solana, manager, and T. M. Ticknor, secretary-treasurer.

Clyde, N. Y., will have in operation within a few weeks a complete telephone exchange. Many of the leading business men of the town have entered into the scheme. Among some of those interested are the following: A. M. Graham, Charles D. Ely, G. B. Greenway, Charles A. Lux, Charles R. Kennedy and E. Sands.

The opening of the long distance telephone line, connecting Columbus, O., with the East, was successfully accomplished two weeks ago when Mayor George J. Karb conversed with New York. Boston and Chicago were afterward reached. H. J. Curl, of the American Telephone & Telegraph company at Pittsburg, opened the line.

The new cable which the Central Union Telephone company is stringing on the East Side, says the *Dispatch* of Columbus, O., was damaged in a peculiar manner last night. Men were stringing the cable in the vicinity of Parsons avenue and Oak street, and in some manner allowed some slack of the cable to drop down upon the wires of the Columbus Electric Light company near the Oak street engine house. When the electric current was turned on the lead casing was rapidly melted and the wires in the cable damaged.

If the assertion of a New York electrical man may be believed the latest thing in Eastern electrical circles is a dummy telephone. Just to what service such an outfit could be put is puzzling at first sight, but according to this same gentleman they are intended to partly do away with the nuisance of the chronic user of other people's telephones. He says:

"In the first place they are a necessity to a busy man who does not keep a public telephone, and in another place they present an excellent means for getting rid of bores who don't intend to be bores, who don't know that they are bores, and who would resent any supposed discourtesy in a pretty emphatic way. Since the telephone came into general use and pay stations were established a class has also come into being composed of people who want to use a 'phone perpetually and eternally, but whose messages are not important enough to warrant the expenditure of a dime. These people always want to use a 'phone whenever they see one, and as they are becoming more numerous every day, the dummy 'phone has been introduced. It looks exactly like a telephone, but is made of papier mache. When a man asks to use your 'phone and you have a dummy, you just refer him to it, and then he rings away for 'central' until he wearies of getting a reply. Of course, he thinks the instrument is out of order. He may come in at some other time and ask to use it again, but he never comes the third. Two whacks at a dummy telephone will break the biggest telephone beat in existence of ever trying to use it again."

## MISCELLANEOUS.

*The Aluminum World*, New York, has made its appearance. The new journal is to be issued each month, and its first number presents a creditable appearance. Of particular interest are two pages devoted to the relation between electricity and the metals.

A German electrical company manufactures a life-buoy which is provided with an electric lamp so as to be visible at night in the water. The floating apparatus is made of waterproof linen, and is sufficient to bear the weight of three persons in the water, life belts being attached to the buoy. Inside the canvas buoy is a double wooden box containing an accumulator with gelatine material, and it is capable of feeding an incandescent lamp for six hours. The lamp surmounts the floating buoy in a strong wire frame, and is further protected by an outer glass globe. When the apparatus is hanging on board ship, the weight of the lower portion automatically switches off the current, but as soon as the buoy is released and dropped into the water the current is switched on. If not used, the accumulator will last for two months before requiring to be recharged, so that the apparatus can be employed on board ship where there is no dynamo. The apparatus weighs about 100 pounds. It is said that these gelatine accumulators do not suffer from the motion of the ship or from the fall into the water.

## TRADE NEWS.

The E. W. Bliss company, Brooklyn, N. Y., manufacturer of flexible friction clutch pulleys, has issued a complete and tastefully illustrated catalogue which contains a number of tables pertaining to the use of clutch pulleys.

The American Electrical Works, Providence, R. I., are sending a pack of playing cards to their friends and the trade. In the way of an advertisement this enterprise is worthy of more than "passing" notice. It is characteristic of the policy of the American Electrical Works that the deck only contains four aces, for fair dealing and no bluffing are associated with the concern's name. The American Electrical Works believe in "calling a spade a spade" and insists that their electric light wire, magnet wire, office and annunciator wire, rubber covered wire, lead incased wire, telephone and incandescent cord, etc., are superior in every particular.

The statement of the College of Engineering, Metallurgy and the Mechanic Arts of the University of Minnesota, Minneapolis, presents some of the advantages possessed by the institution for a course in electrical engineering. The department of electrical engineering is associated with the department of physics, and has free use of all its apparatus and facilities for work. This includes three rooms with eight solid masonry pillars for the support of sensitive instruments, dynamo room with engine, dynamo, motors, etc., battery room, four laboratory rooms for general work, photometer room, photographic room, library and reading room; professor's private study and laboratory. All the rooms are wired for electric light, time, experimental current and call bells. In the attic are a meteorological room and a photograph room, provided with exposed window, skylight, etc., and a large dark room for arc light photometry. The department of physics possesses a large and valuable collection of apparatus for lecture purposes and practical laboratory work, and offers many inducements to students contemplating a course in electrical engineering.

A glance at the store of the Metropolitan Electric company, 186 and 188 Fifth avenue, Chicago, warrants the assertion that the company has confidence in the brightening business prospect and shows the remarkable manner in which it has added to its list of electrical supplies and specialties in the last six months. The company's store is a spacious one and is supplemented by a basement of generous proportions. It has been the policy of the Metropolitan company to carry a sufficient stock of its goods to enable it to fill large orders promptly from stock, and the store, both on the ground floor and in the basement, is filled with the various articles which make up the electrical supply business. The stock is an ever-changing one, however, for large orders are being filled daily for all classes of supply material. P. & B. products occupy the front portion of the basement, and insulators, wires, including telephone and telegraph wires, N. I. R. wire, flexible cord, magnet wire, waterproof line wire, etc., linemen's material, railway supplies, electric fixtures, annunciators, cells, bells, lamps, etc., are stored upon both floors. The company is constantly adding to its agencies and has just arranged to handle the entire output of a large glass factory in the western territory in glass insulators. This is a very important arrangement and will enable the company to carry at its Chicago store a large stock of insulators for prompt shipment as well as to sell at factory prices. This line will include pony insulators, double petticoat pony insulators, Western Union deep grooved and double petticoated deep grooved insulators, deep grooved railway and special oil, insulators as well as glass knobs and all special forms of insulators demanded by electrical specifications. William H. McKinlock and Walter C. McKinlock, president and secretary of the Metropolitan Electric company, certainly deserve congratulations upon their successful effort to establish a large electrical supply house founded upon substantial business methods and the success with which it has met in the last six months.

Satisfactory examples of pleasing practice in designing trade literature are disseminated by the General Incandescent Arc Light company, New York, of which S. Bergmann is president. The latest advertising matter issued by the company is descriptive of the various styles and designs of the new Bergmann alternating arc lamp, and is noteworthy because of its neat appearance as well as its interest to those desiring ideas in arc light practice. The Bergmann lamp has many points of value to recommend it for consideration. Its mechanical parts are few and simple, consisting of only two wheels and one magnet; there are no springs for the adjustment, consequently neither time nor change of temperature can affect the absolute steadiness of the light; there is no escapement, hence the regulation or feeding is not step by step, but continuous, and the voltage and amperage never vary, and when trimming the rod or chain, as the case may be, can be moved down instantly; there is no series coil to burn out and no dash-pot to stick; the method of hanging the globe by means of chains and protecting nets furnishes the quickest and safest method of trimming, and the carbon holders are adjustable to any size of carbon. These lamps have been used with great success by numerous concerns, and the General Incandescent Arc Light company has received many letters in which purchasers express in warm terms satisfaction at the successful working of the lamp. The company is also calling attention to the compound arc light switch. This switch is designed for connecting three arc lamps in such a manner that either two or three lamps can be burned at will. In one position the switch connects the two lamps in series across the circuit in the usual way; in the next position these two lamps are put in multiple with each other and in series with the third lamp; the third position of the switch turns off all the lamps.

## BUSINESS.

The St. Louis Iron & Machine Works, St. Louis, Mo., are building a 350 horse power St. Louis Corliss engine for the Pekin, Ill., Electric Light company.

The Washington Electric company, Chicago, received several large orders for its well known arc lamp last week which will keep the company busy for some time.

The Western Electrical Supply company, St. Louis, announces its removal on September 1st to Nos. 10 and 12 North Ninth street. A large and complete stock of electrical supplies, dynamos, motors, gas and electric fixtures will be carried by the company.

Goltz & Sinclair, Milwaukee, report the following contracts closed during the last few weeks: Wisconsin Bridge & Iron company, furnishing and installing two General Electric 25 horse power railway motors on the Sixteenth street folding bridge; George P. Miller, wiring residence for 150 lights; People's Theater, wiring for 250 lights; Dr. Brown's Hospital, wiring for 150 lights.

The Berlin Iron Bridge company of East Berlin, Conn., will furnish the iron roof trusses for the new city armory at Pawtucket, R. I. The new power house for the Bridgeport Traction company, at Bridgeport, Conn., consisting of a dynamo room and a boiler room, will be designed and built by the same company. The dynamo room will be furnished with a traveling crane, furnished by the Berlin company.

One of the most important agencies of the Metropolitan Electric company, Chicago, is the Royal transformer. These transformers are being made especially for the Metropolitan company. As soon as possible the company will carry a full stock. It is now booking orders and has found a ready demand for a good transformer in all sections of the country. The company has also taken the agency for the Commercial Electric company's dynamos and motors, and carries a large stock from which to fill orders promply.

The Mather Electric company, Manchester, Conn., report on hand a large number of contracts for its new multipolar railway generators for railway work. The company has closed the following contracts: The Danbury & Bethel Horse Railway company, Danbury, Conn., two 100 kilowatt multipolar railway generators with switchboard, which will be fitted entirely with new Mather station instruments; the Chicago City Railway company, Chicago, Ill., one 125 horse power directly connected generator.

The new switchboard for the Castle Square Theater of Boston is one of the handsomest productions of the W. S. Hill Electric company. There are a number of 1,000 ampere four-pole switches on the board, which is of selected blue slate, highly polished, having upon it every known device for controling the best illuminating effects for stage work. The entire construction is massive, all parts of copper being of extra strength and carrying capacity. This installation is one of the best in the East, reflecting great credit upon the W. S. Hill Electric company.

The Norwich Insulated Wire company of New York has just closed a contract with the West End Railway company of Boston for the underground cable, which is to be placed underground this winter, in accordance with the underground ordinance recently passed. The contract was made through the New England manager of the company, E. P. Parsons. Magnus F. S. Von Loescke, who was for a long time employed at the Thomson-Houston works, and is at present the electrician of the Norwich company, will have charge of the laying of the wires. It is expected that over 30 miles will be placed underground before January 1st.

The Electric Appliance company, Chicago, has arranged to represent the Heisler series lamp exclusively in the West and to carry a large and complete stock in Chicago. The advantage of this policy will undoubtedly be appreciated by users of series incandescent lamps who have heretofore

been compelled to send their orders to eastern houses for shipment direct from eastern points. The Heisler series incandescent lamp is too old and well known an article to require any comments, and the Electric Appliance company has undoubtedly added another good specialty to its line of electrical goods.

George N. Crawford, the Chicago representative of the Watertown Steam Engine company, has just secured an order from the Louisville, New Albany & Chicago Railroad company for one 100 horse power high speed automatic engine. Within the last few days the factory has also received from the same territory orders for a 100 horse power high speed engine from an electric light and power company of Grand Island, Neb.; a 50 horse power directly connected high speed engine for the Western Electric company of St. Louis, and a 150 horse power high speed engine for Jacksonville, Ill.

In order to meet the demand for the Pope light for train lighting, the Consolidated Car Heating company has added considerably to its plant and is about to manufacture lamps for compressed oil, gas and fittings on a large scale. The compressed gas plant recently erected shows most excellent results. 17,600 cubic feet of gas of 50 candle power having been obtained from 160 gallons of oil, that is, 110 feet per gallon, whereas the usual make is said to be something under 90 feet. The Consolidated company is preparing to invite railway men from all over the country to witness an exhibit of Pope lighting apparatus at Albany, carrying out a similar plan to that it established in 1892 with reference to steam heating apparatus, when special trains were run hourly to Troy and return during two days, and many prominent railway officials from all parts of the country and Canada were present to observe the operation of the Sewall coupler and Commingler storage systems.

The following is a list of the sales of the Chas. E. Gregory company, Chicago, for September: Home Electric Light & Power company, Elkhart, Ind., one 50 light American and one 50 light Standard arc dynamo, 100 lamps, 100 hoods and 100 globes; Mrs. S. Livingstone, Chicago, one one horse power Eddy motor; Eugene Vallens & Co., Chicago, one one horse power Belding motor; Barrett & Barrett, Chicago, one two horse power Excelsior motor; Henry Electric company, Henry, Ill., one 30 light Sperry arc dynamo; O. H. Parker, Anniston, Ala., one 25 horse power C & C motor; Ford & McGregor, 21 Edison arc lamps; T. Braasted, Ishpeming, Mich., one five horse power T.-H. motor; D. A. & C. A. Goodyear, Tomah, Wis., one three horse power Jenney motor; Hatch Cutlery company, Buchanan, Mich., one 25 horse power Edison motor; Taylor, Dee & Mack, Chicago, one two horse power Sprague and 110 horse power U. S. motor; W. Kreilow, Willow Springs, Mo., four "D" T.-H. lamps; Lederer & Oppenheimer, Chicago, 14 Edison arc lamps; R. Roach, Chicago, one three horse power Eddy motor; Four Lakes Light & Power company, Madison, Wis., one three horse power Jenney and one three horse power Eddy motor; Crane Elevator company, Chicago, one one horse power Crocker-Wheeler motor; Goltz & Sinclair, Milwaukee, one one horse power Eddy motor; Racine Dredging company, Gladstone, Mich., one three-light Excelsior arc dynamo; Field Columbian Museum, Chicago, one 45 light Brush arc dynamo and 45 lamps; D. S. Huff, Morris, Ill., one 1½ kilowatt Edison motor; Chicago Turn Gemeinde, Chicago, one five horse power Excelsior motor; Dundee Rapid Transit company, Elgin, Ill., one 20 horse power Sprague motor; Quincy Floor Plate Manufacturing company, Quincy, Ill., one 50 light U. S. dynamo; Metropolitan Electric company, Chicago, one seven light Bain dynamo.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued September 25, 1894.*

526,392. Conduit for Electric Railways. David F. Graham, Springfield, O., and William P. Allen, Chicago, Ill. Application filed October 25, 1893.

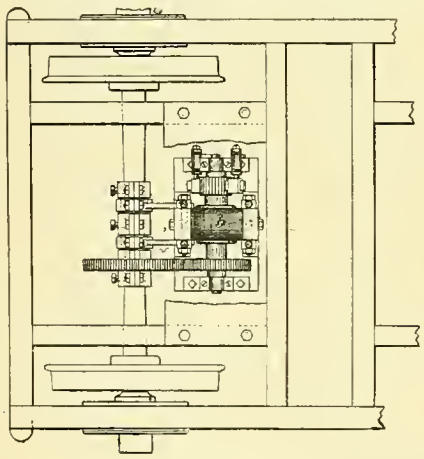
Extending along the conduit, either inside or out of the conduit, are feed wires insulated and provided at suitable intervals with branched connections, which extend into switching devices. Extending longitudinally through the conduit above the conductors and below the slotted opening are hinged plates or covers hinged to suitable projections at the sides of the conduit, and when in their normal position adapted to contract, so as to completely cover the conductors; the plates being slightly removed from the sides of the conduit at the point where they are hinged, and arranged on an angle, so that any water or moisture or other substance which falls through the slotted opening will be directed to the sides of the conduit and thence to the bottom and to a sewer or other point of discharge.

526,408. Bracket for Trolley Wires. Leroy S. Pfouts, Canton, O. Application filed December 30, 1893.

One of the objects of the invention is to provide a stationary pole, with an arm at right angles with the pole, which supports a trolley wire, and which is allowed to be moved in an upward direction upon the passage of a car, thus greatly lessening the jarring of the pole and doing away with much of the wear and tear upon supports of the trolley wire.

526,409. Trolley and Feed Wire Bracket. Leroy S. Pfouts, Canton, O. Application filed January 11, 1894.

The construction of the bracket is such that the feed wire will act as a counter-balance to a certain extent, thus allowing the free end of the arm to be easily lifted as the trolley passes.



No. 526,432.

526,414. Electric Signal Apparatus. Wilmer W. Salmon, Chicago, Ill. Application filed February 1, 1894.

The invention comprises a motor, a device to be moved by it, and means for retarding the moving parts when they have completed a predetermined movement. In the present embodiment the invention is applied to a railway signal. A magnetic brake is employed to retard the movement in both directions, being thrown into operation just before the signal has fully assumed its indicating position.

526,415. Electric Signal Apparatus. Wilmer W. Salmon, Chicago, Ill. Application filed February 1, 1894.

In the invention are embodied an electric motor, an operating circuit and a cushion circuit therefor, and a device to be moved by the motor, the circuits being so operatively connected with the moving parts that when they have completed a predetermined movement under the mechanical operation of the motor the cushion circuit is energized to retard the moving parts.

526,432. Means for Driving Dynamos from Car Axles. William Biddle, Brooklyn, N. Y. Application filed October 20, 1893.

A transverse plate or girder resting upon, supported by and connected to the truck frame is provided, as well as links in pairs depending from the transverse plate or girder, the lower ends of which links are connected by bolts to the opposite sides of the pole pieces of the dynamo. The inventor prefers to form sockets in the upper face of the transverse plate or girder and cup-shaped bearers upon the upper ends of the links resting in the sockets, the cup-shaped bearers being secured upon the upper ends of the links by the nuts. The dynamo thus supported has a slight freedom of movement to compensate for vibration and jar of the car truck, and links formed with rings at one end to surround a sleeve upon the car axle are provided, the other ends of the links being connected by a bolt to one of the pole pieces of the dynamo, thus holding the dynamo at a constant and unvarying distance from the car axle, so that there is no liability of the gear wheel and pinion being disengaged. The dynamo is intended to be used for lighting the car through the medium of storage batteries.

526,422. Trolley Wire Hanger. Irvin B. Walker, Sioux City, Ia. Application filed February 26, 1894.

The trolley wire hanger is constructed of a single piece, and has a central lip grooved upon its upper surface for the reception of the wire, the ends of the hanger extending longitudinally beyond the lip and over the wire and being grooved upon their under edges; the distance between the bottom of the groove in the ends and a line extending from the bottom of the groove at the extreme corners of the lip being the diameter of the wire, the hanger being concave at the point of contact with the wire and convex on the side opposite to it, the entire lower portion of the hanger being of the width of the diameter of the wire

526,434. Joint for and Method of Joining Metal Bars. William M. Brown, Johnstown, Pa. Application filed March 23, 1894.

In general the method consists in fitting against rails or other kinds of bars at the point to be welded a metal chock or chocks, and after heating the chocks and rail to a welding heat the chocks are squeezed together, whereby the whole is united into one integral mass.

526,468. Closed Conduit for Electric Railways. Charles D. Tisdale, Boston, Mass., and John D. Gould, New York, N. Y. Application filed September 4, 1893.

The principal idea of this invention consists of a tube of flexible material, a main conductor inserted in the tube, an auxiliary sectional conductor placed upon the tube and provided with contact pins extending through the walls of the tube, in position to be brought into contact with the main conductor when the auxiliary conductor and the tube are compressed by the trolley carried by the car.

526,472. Insulator for Electric Conductors. George Webster, Philadelphia, Pa. Application filed July 26, 1894.

An insulator having a perforation through its entire body, a deep and shallow recess adjacent to one another in its face, the deep recess forming a channel, the opposite ends terminating in kerfs formed in the wall of the recesses, and means for securing the electric conductor therein, are described.

526,498. Conductor Support and Insulator. David N. Osyor, Columbus, O. Application filed November 29, 1893.

The insulator patented is designed to overcome the difficulties met with in ordinary insulators, especially in wet or freezing weather, when the water freezes about the wires and short-circuits the current, rendering the wire useless and making work over the wires an impossibility. It is especially adapted to mines when electrical work is going on.

526,487. Electrical Measuring Instrument. Hermann Herberts, Schenectady, N. Y. Application filed March 5, 1894.

The principle upon which these instruments are based is to send the current to be measured in two electrically parallel branches or circuits around the needle or armature of the instrument, thus exciting two distinct polarities in the latter. Since—in ampere meters—the sectional area of the exciting coil conductor is to be made in proportion to the strength of the current, the flow of which is to be measured, it is evident that, in order to cover all practical cases of application, these instruments have to be made in all variety of sizes.

526,502. Electrical Safety Fuse. Otto M. Rau, Milwaukee, Wis. Application filed October 31, 1893.

The inventor has discovered that by constructing a fuse in the nature or form of a helix or coil in which the successive turns or convolutions lie as closely together as possible without touching each other or affording a short-circuit between the turns or convolutions, it will always rupture at or near its mathematical center or at some point between the consecutive turns or convolutions of the helix, never rupturing at or near the points where it is secured to the binding posts. In this fuse the turns in the helix are closely adjacent to each other, and the helix is without any additional support other than furnished at the binding posts.

526,549. Attachment for Speaking Tubes. William Weber, Philadelphia, Pa. Application filed December 30, 1893.

The invention combines an ear-piece and a mouth-piece by means of a rigid tubular connection, so that both may be held in the hand by means of the tube, the ear and mouth-pieces being arranged at such relative distances from each other that the voice of the speaker will be necessarily at the proper distance from the mouth-piece, and the latter be maintained by the rigid connecting tube in the opposite lateral plane from that in which the ear-piece is supported thereon.

526,580. Trolley for Electrical Conductors. David N. Osyor, Columbus, O. Application filed December 6, 1893.

One of the objects of the invention is to provide a trolley carriage which will be firmly held at all times on the conductors, but which shall at the same time be possessed of a certain flexibility, so that it can readily travel over uneven places in the conductors. Provision is made for variations in the distances between the conductors, and also for the swerving of one or the other, or both, from the normal lines.

526,583. Voltage Regulator for Dynamos. Malcom P. Ryder, New York, N. Y. Application filed May 12, 1894.

The combination with the regulator magnet and the swinging armature of the circuit-breaker actuated by the armature and comprising a slide plate, a conducting block insulated thereon, and conducting springs secured to a stationary support and adapted to contact with the conducting plate, are described.

526,598. Electric Cab Signal for Railways. Edgar C. Wiley, Bristol, Tenn. Application filed January 31, 1894.

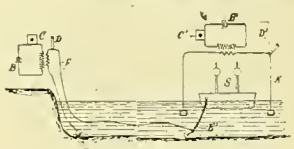
The invention relates to that form of cab signals in which an alarm bell is carried upon the locomotive, and has a local battery and circuit connections operated by induction through inducing magnets placed along the road bed, an example of which may be seen in the patent already granted the inventor, dated February 6, 1894.

526,605. Rheostat. Burton E. Baker, New Britain, Conn. Application filed June 4, 1894.

The inventor describes a rheostat consisting of cores having resistance wires wound around them, blocks of plastic material in which the cores are embedded, clamping pieces having recesses to receive the blocks, screws adapted to be passed through the clamping pieces and nuts on the screws, whereby the blocks are locked in position between pairs of clamping pieces.

526,609. Submarine Signaling. Lucien I. Blake, Lawrence, Kas. Application filed July 6, 1894.

In the illustration *A* is a shore station and *S* a light ship. At the station *A* is a battery *B*, a telephonic transmitter *C*, and a receiver *D*. The batteries and telephones are shown as connected up in a local circuit, the line being a secondary or in-



No. 526,609.

duced circuit through the secondary *F* of a suitable step-down induction coil, or one in which a current of high potential in the primary is converted to a current of lower potential in the secondary. The line is an insulated cable or conductor *G*, grounded at *E*, at or near the shore station *A*, and extended out, as indicated, to the desired location of the electric region to a submerged plate or conducting body, which in the present instance is shown as the anchor *E'* of the vessel *S*. It appears with the arrangement illustrated, and when electric impulses are transmitted over the circuit, that an active or electrified region, which may be designated as the region of communication, is established in the water, around each terminal plate, and extending between them, if they are not too widely separated, and that a difference of potential exists between any two points therein at unequal distances from either terminal plate. The two immersed terminals of the cable may be at a very considerable distance apart, even to many miles, and wholly independent of each other, so that no current actually flows from one to the other, but if from any vessel as *S* lying at any point in this region of communication the ends of a conductor *K* be let down into the water so that it connects two points at unequal distances from either terminal *E* and *E'*, electric impulses will pass in the conductor corresponding to those transmitted through the cable from the shore station *A*. A telephonic receiver in the conductor *K* will reproduce the signals or speech thus transmitted. Instead of including the transmitter on the ship directly in the conductor *K*, it is desirable to employ a transmitter *C'* and a battery *B'* in a local circuit, including the primary coil of an induction coil, the coil of low resistance of which is in the circuit of conductor *K*. It has been found necessary, however, in order to transmit speech in this way to employ telephonic receivers especially constructed of exceedingly low resistance, in comparison with ordinary telephones, and determined for each case in every special feature by the size of the terminal plates of the conductor *K* and the specific conductivity of the medium in which they are immersed.

526,644. Testing Indicator for Electric Railway Cars. Theodore Stebbins, Boston, Mass. Application filed August 21, 1890.

One of the claims is for an electric testing indicator comprising, in combination, an electric apparatus or circuits to be tested, an indicating instrument and an electric switch or contact-making appliance having connections to the ground, the indicating instrument and the circuit or apparatus, or parts of it, to be tested for connecting a terminal of the indicator, either to ground or to a source of current, and the other terminal to any part of the circuit or apparatus to be tested at pleasure.

# Western Electrician.

EVERY SATURDAY.

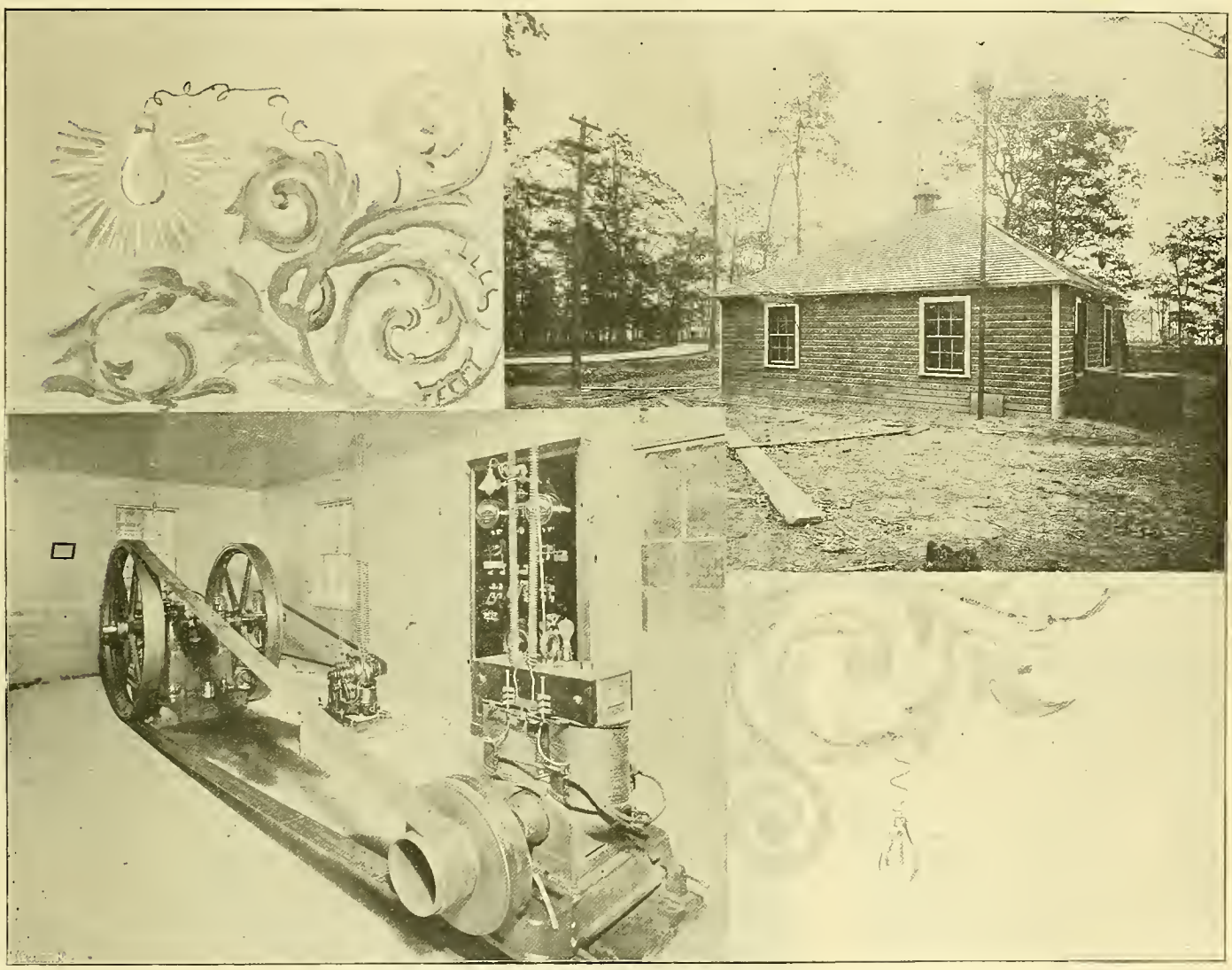
Vol. XV. CHICAGO, OCTOBER 13, 1894. No. 15


## Storage Batteries for Private House Lighting.

The theoretical applications of the storage battery are manifold, and are as varied in character as the demands for a source of electrical energy are numerous. Ideally, an article to which energy may be imparted, and there preserved until required, is of great value in these days when mankind is gradually substituting machinery in a considerable percentage of the cases where manual labor was formerly employed. Practically, the storage battery, while rapidly growing in popular favor, as it becomes more intimately known, gives more promise for the undeveloped future than almost any other article ot the industrial world. In this country, particularly, it must overcome a great deal of prejudice and ill-will from those who have been victims of the claims of over-zealous enthusiastic promoters, and from those who have failed to sincerely examine the claims now made by reliable companies having a valuable article meriting inspection. The storage battery has had to overcome the faults of imperfect mechanical and electrical construction, a task made the more difficult by legal difficulties; it has been obliged to suffer from unskilled care and from a general ignorance of its operation. Yet it is a noteworthy fact that in spite of these obstacles its manufacture and introduction has been attended with success, and attention is now being attracted to it more than ever before. Three years ago many of the leading electrical companies were not to be approached by storage battery agents. It was assumed then by competent judges of practical working conditions that there was no battery to be had in this country which could be relied upon. In this connection it is worthy of note, and speaks for itself of the growth of confidence in the ability of the storage battery to meet fair requirements, that the New York Edison Illuminating company a short time ago contracted for a total capacity of 1,200 kilowatt hours of the Electric Storage Battery company. This contract would have been deemed impossible a few years ago.

It is not surprising when such advancement was being made in the larger storage battery interests of this country that their advantage in a smaller way was equally as prominently noticed. As a source of illumination for isolated private dwellings or institutions their use in connection with a dynamo and a gasoline engine is in many respects ideal. No more satisfactory example of their use under these circumstances could be obtained than the lighting plant installed at the summer residence of Byron L. Smith of Chicago, at Lake Forest, Ill. The mansion, as shown in Fig. 3, is a spacious one, three stories in height, and located upon one of the prettiest parts of the Lake Michigan bluffs north of Chicago. Mr. Smith is one of the directors of the Chicago Edison company, and when his surburban property was wired for electric lighting great care was taken in making the plant a perfect one in all respects. At first only a gasoline engine and a dynamo were installed, but for many reasons the advantages of an efficient storage battery plant presented themselves, and in such a forcible manner that the Chicago Edison company was given authority to install a battery plant which would best meet the requirements in the case. The choice of the company fell upon the chloride cell made by the Electric Storage Battery company of Philadelphia, which was accordingly installed. Since this addition the plant has become of more than ordinary interest as being an excellent example of a type which will doubtless multiply to a considerable extent in the next few years.

About 500 feet from the residence is the "power house," a frame building of neat appearance, 21 by 27 feet in dimensions. It is divided into three rooms, including a workshop, and an attic. The dynamo room, 12 by 26 feet, is shown in Fig. 1, the house itself in Fig. 2 and the battery arrangement in Fig. 4. The circuits are led from the dynamo room upon glass insulators to the pole line, which passes through a wooded grove on its way to the residence, in this way concealing its presence to a great extent. The poles are of cedar and carry two circuits as well as a telephone wire—one of No. 0000 wire, supported upon double petticoated glass insulators, and pressure wires of No. 4 B. & S. gauge. The line is suitably provided with lightning arresters and near the residence is led underground in iron pipes and lead-covered cables. It enters the house in the basement, where a knife switch mounted upon a slate base controls the house circuits. Each of the three floors and the basement is provided with independent cut-out boxes, entirely enclosed in slate and built in the shaft of a dummy waiter which runs from the basement to the top floor. The house is wired upon the Edison three wire convertible system, and interior conduit is used throughout. The fixtures are of tasteful designs and consist mostly of groups of lamps in frosted globes, harmonizing perfectly in all cases with the mural decorations. The use of electricity in this country house, miles from any other source of electrical supply, is the more delightful as it is attended with no noise and no



FIGS. 1 AND 2. STORAGE BATTERIES FOR PRIVATE HOUSE LIGHTING.

moving machinery in the house, and it is in keeping with the pretentious surroundings. The grounds adjacent to the house are to be electrically lighted next year. At the present time 256 lights are wired up, 237 in the residence and 19 in the barn, dynamo room and some outlying sheds.

In the picture of the dynamo room is shown a Lewis 15 horse power gasoline engine belted to a 12 kilowatt Edison bipolar dynamo, shunt wound for 96 amperes at 125 volts, when running at 1,600 revolutions a minute. Between the two is a Crocker-Wheeler "booster," while the switchboard is seen at the right.

The Lewis gas engine is manufactured by the Webster Manufacturing company, Chicago. It is claimed for this engine, which is of the horizontal type, that it is especially adapted to charging storage batteries. Ignition is either by flame or by an electric spark. In this installation several small chloride cells are used. A great deal of attention is given to gas engines at the present time in connection with electric lighting work, partly from an economic standpoint and partly from a consideration of some of their claims for recognition over the steam engine. In the Lewis engine there are no intricate parts; everything is open and in plain view, and the exhaust pipe is connected with a cast-iron exhaust box, which muffles the noise, so that the engine is comparatively free from unpleasant sounds. The action of the governor of the engine is positive, and, making an explosion every other revolution, it recommends itself particularly for electric lighting. High pressure water mains are laid upon Mr. Smith's estate, and a hydraulic pump and friction wheel are used in starting the engine. Gasoline is kept in a tank immediately in the rear of the engine house, from which it is pumped directly into the building. It is interesting to note that the Webster company, taking as a basis the charge of one cent per lamp hour and that 100 lamps burned on an average of four hours per day will cost $104 per month, claims that by the use of a gasoline engine and dynamo the same amount of light would cost about $25 (varying somewhat under local conditions) for gasoline, lamp renewals, oil, etc.

The field of the "booster" used in this installation is separately excited from the bus bars of the board; the armature is wound for 40 amperes at 25 volts and is connected in series with the battery-charging feeder. The charging rate is governed by a rheostat introduced into the field circuit of the "booster." Both the dynamo and "booster" are mounted upon four-foot brick and concrete foundation.

Of particular interest is the battery room, which has been set up according to the best and latest practice. As seen by the picture, the cells are excluded from exterior disturbances by four closely fitting doors, two of which have been taken off to allow a clearer view of the arrangment of the cells. Sixty type 11 E 250 ampere hour cells of the chloride accumulator inclosed in glass jars have been placed in position. They are divided into four rows and are set on shelves consisting of 2 by 8 inch boards with 4 by 4 inch upright supports. The doors and supports are painted with P. & B. compound, and an air space 2 inches wide leading to a ventilator in the roof is provided. The whole battery rack occupies a space of but 6 by 12 feet, and, although safe from interference and free from dust, etc., is readily accessible. The chloride cell used in this installation has become extensively introduced in this country during the last few years. The elements are made of cast plates, or pastilles of a salt of lead, inclosed in a dense frame of metal cast around under heavy pressure; this plate of lead salt, so framed is then reduced electro-chemically to pure metallic lead. The plate is thus entirely composed of metallic lead, partly in compact form, partly in minute crystalline subdivision, differing from a plate of cast or rolled lead only that some of its parts are of a crystalline character, a difference purely mechanical, in no-wise chemical. These plates, requiring oxidizing, are then put with alternate lead plates in a cell with an electrolyte, and current is passed through them for a sufficient time to convert the pure crystalline metallic lead into peroxide of lead. These cells combine the advantages of a superior mechanical and electrical connection between the frame and the active material and the formation of the latter by means which insure absolute uniformity and maximum porosity. The weights for a given capacity of this cell are largely reduced, and the floor space is, therefore, proportionately less. The great porosity and unique and uniform construction of the plates admit of the battery being discharged at very high rates, in one to two hours, if necessary, without detriment or risk of damage. The possible rate of charge is also very high. Frederick L. Merrill, Chicago, was in charge of the storage battery installation.

The switchboard, shown in Fig. 2, is 3 by 5½ feet, and is made of polished black slate. Upon it are mounted a Weston ammeter and voltmeter, a voltmeter switch, an Edison solenoid amperemeter, a battery cell switch, an automatic cut-out and an automatic overload switch for the battery, a Carpenter enamel field rheostat, a field rheostat for the "booster" and three double-pole knife switches connecting the dynamo to house, dynamo to battery and battery to house.

The usual practice is to run the dynamo during the daytime to charge the storage battery plant, and to run the house lights direct from the battery. Upon occasions when a heavy load is expected, however, the dynamo may be thrown

FIG. 3. STORAGE BATTERIES FOR PRIVATE HOUSE LIGHTING.

into service and current furnished for the entire capacity in lamps. The plant is the source of considerable interest in the neighborhood, and thus far has given the most complete satisfaction. It is in charge of J. W. Johnson.

A remarkable instance of the eccentricities of lightning occurred recently in connection with this installation. During a thunder and lightning storm, lightning struck the line, which is amply provided with arresters for such an emergency. Disregarding them, however, the discharge entered the house and jumped from a wall switch to the steel lathing, thereby grounding both of the feeder lines to such an extent that the over discharge switch was actuated and cut off the battery from the house, probably preventing a fire loss.

## Electrical Power Transmission from Laucherthal to Sigmaringen, Germany.

As an example of electrical practice more common in continental Europe than in this country the installation recently made by the Elektricitäts Aktiengesellschaft, formerly Schuckert & Co., at Laucherthal in the province of Hohenzollern, Germany, for the transmission of electrical power to Sigmaringen, is interesting. Laucherthal is located upon the Lauchert river at a point where there is a considerable waterfall, which has been utilized for power purposes in the town, where there are several rolling mills. As the power at hand was more than enough for the needs of Laucherthal, the project of transmitting the surplus in the form of electrical energy to the village of Sigmaringen, a little more than three miles distant, was considered and finally accomplished by the use of a direct current of high potential delivered at a sub-station, and thence distributed for power and lighting purposes at a considerably lower voltage.

The plan of the generating station at Laucherthal, as plainly shown in Fig. 1, comprises the use of three dynamos and two turbines. The turbines are of the type manufactured by Voith of Heidenheim and are rated for a maximum capacity of 182 horse power at a speed of 115 revolutions a minute. These turbines furnish power for two dynamos of 90 horse power capacity each; a third dynamo is held in reserve for use in case of the disability of either of the other two machines. As seen in the illustration the turbine shaft is geared to a horizontal shaft, provided with clutches and pulleys, which drives the dynamos by means of belting. Special foundations were built for the support of the shaft and much attention was paid to the controlling devices of

FIG. 4. STORAGE BATTERIES FOR PRIVATE HOUSE LIGHTING.

the shaft. The dynamos may be run separately, or any of the three in pairs, from either of the turbines.

The generating dynamos in the primary station are of the four-pole type and each supplies 61 amperes at a potential of 1,100 volts when running at a speed of 460 revolutions a

minute. The three-wire system is used. Fig. 2 shows the general scheme of distribution. The switchboard contains the usual switches, measuring instruments and safety devices. The wiring, of course, is so arranged that any one machine may be coupled with either of the two others. A signaling system is incorporated upon the board to control the regulation of the rheostats. There are also automatic devices intended to work in case of short-circuits on the line.

The line, about three miles in length, is made up of two copper cables and a cable of smaller section, carried upon porcelain insulators mounted upon wooden poles. The poles are a little over 30 feet in height and are placed about 150 feet apart. A telephone line is also carried, and instruments are placed at several points. These special precautions have been adopted, especially at places where the line crosses railway tracks, so that in case of an emergency notification could be given promptly to the stations. In Fig. 3 is shown an exterior view of the sub-station at Sigmaringen, an interesting feature of which is the wire tower.

The sub-station at Sigmaringen contains, as seen by Fig. 4, three motor-generators. The machines have each four pole pieces and in each set the armatures of each are keyed together and perfect alignment secured. One acts as a series excited motor and receives 61 amperes at 940-volts pressure at the brushes. Its speed is 410 revolutions a minute and it operates a dynamo, excited in shunt, which at the same speed gives 170 amperes at 260 volts, or nearly 45 kilowatts. In connection with the station is a plant of Pollak accumulators of 750 ampere hour type, which is charged during light load, usually by changing the speed of one of the motor-generators to suit the requirements of the battery. Two sets are ordinarily run together and the third held in reserve. In common practice either one dynamo may be run upon the two-wire system or two dynamos, utilizing the three-wire system. This installation has been in operation about six months, and there are in use 3,000 incandescent lights, 20 arc lamps and a considerable number of motors. The accompanying illustrations are reproduced from *L'Industrie Electrique*.

## The New Electric Station.

By Electricus.

"Just the place for a station," th' electrician exclaimed
As he placed a new dot on his map.
"Just the place for a station," his assistant proclaimed
As he wiped his hot brow on his cap.
"Just the place for a station, we both do believe,"
Said the boss and the boy by his side,
"Just the place for a station, and we cannot conceive
How what's thrice said can e'er be denied."

So they drew up their plans, which included a pump
And a water wheel, too, of some kind:
For ev'ry one knows, lest he be a great chump,
That water beats steam out of mind.
Then they built them two tanks the water to hold,
And the lower one filled from the lake
Some ten miles away—the project was bold—
They were sure, though, they'd made no mistake.

For 'twas easy to see that with bucket and pail
All the water required could be had
In a trip or two more, or, perchance, should this fail,
In a trip or two less, by the lad.
We've said once before that the project was bold,
And we say it again to be sure:
We say it three times, for what thrice has been told
Will most certainly always endure.

The plan it was this, which I'm 'lowed to reveal—
To pump water from low tank to high
And then let it flow to the said water wheel
And be pumped up again, by and by:
Thus by using the water o'er and over again
The trips to the lake might be stopped,
For the water when pumped would act just the same
As it did when the first time it dropped.

By connecting the pump to the said water wheel
Circulation would ever proceed,
And the dynamo keyed to the wheel's shaft of steel
Would give all the current they'd need.
The project was bold, as we've said once before,
And we say it again, just for fun:
And then we would fain repeat it once more,
For a scheme thrice proposed is half done.

So they wired up the station with high insulation,
With meters for amperes and volts,
And with all other fixings of ingenious creation
As detectors of all kinds of faults;
Nor Niagara nor Culmbanks could ever compete
With a station so carefully planned,
With every detail followed out so complete,
Based on ideas so novel and grand.

It could charge up a bill or electrical belt,
'Lectric combs, tooth and hair brushes, too,
And give current enough to be easily felt,
Which is all that Niagara could do.
That the project was bold you need not be told,
But I think it is best to repeat
E'en a third time, although the story be old,
For what's three times well said is complete.

The plant being now in its most complete form,
Not a bolt nor a wire out of place,
They decided one day 'mid a crowd to perform
The wonders they'd planned with such grace.
So with feelings of pride and pleasure, I wot,
And with other kinds also, I ween,
They turned on the pump, but found they'd forgot
The dynamo-electric machine.

## More Patent Litigation.

The General Electric company has brought an important action for alleged infringement of Edison patents against the Milwaukee Arc Light company, of which W. J.

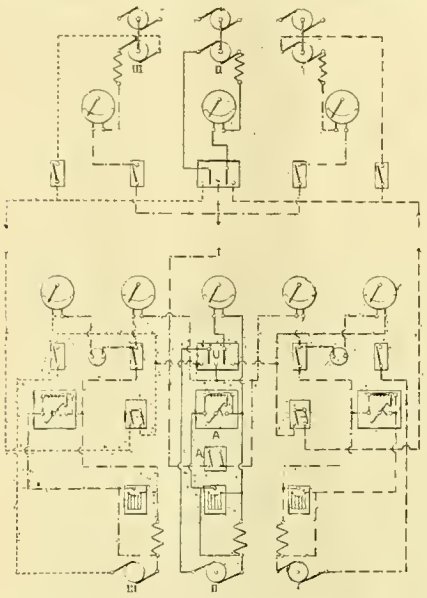


FIG. 2. ELECTRICAL POWER TRANSMISSION FROM LAUCHERTHAL TO SIGMARINGEN, GERMANY.

Fiebrantz is president, Henry A. Adler vice-president, Oscar Altpeter secretary, and G. Wenninger treasurer and manager.

The suits are brought in the name of the Edison Electric Light company and the Edison Electric Illuminating company of Milwaukee by the General Electric company, inasmuch as Milwaukee is the field of the alleged infringement. The suit is over the infringement of a patent designated as "An improvement in the system of electrical distribution." The complaint alleges that on November 27, 1882, Thomas A. Edison obtained a patent for a term of seventeen years on "An improvement in the system of electrical distribution." On March 1st, it is related, the Edison Electric Light company granted the Edison Electric Illuminating company of Milwaukee an exclusive license for the use of its patents. The patent, it is stated, is at present in litigation in the United States courts of New Jersey, in which the Edison company is the complainant and Westinghouse,

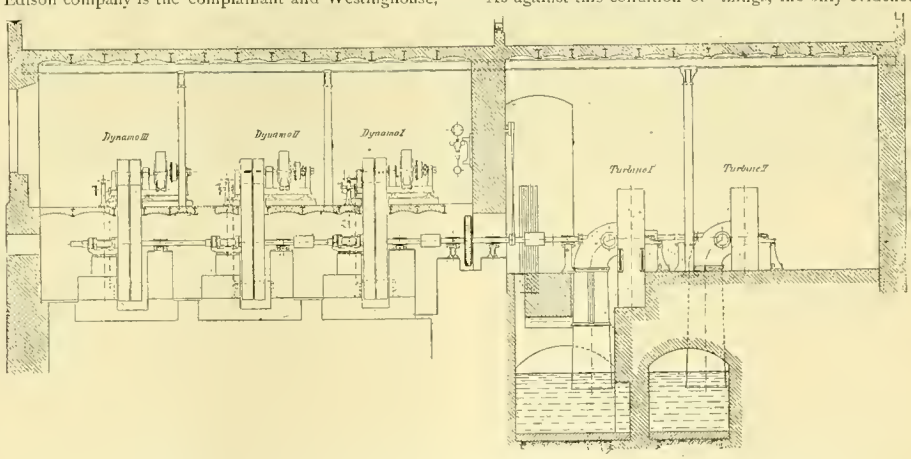



FIG. 1. ELECTRICAL POWER TRANSMISSION FROM LAUCHERTHAL TO SIGMARINGEN, GERMANY.

Church, Kerr & Co. defendants. In this suit the Westinghouse company filed an answer alleging among other things that the invention of Edison was not a new one and that it had been previously described and covered by previous patents. Similar suits were also brought by the Edison company against the New Haven Electric company in 1887 and against the National Electric & Construction company and against the Mather Electric company of Connecticut. In each case the contention of the defendants was the same, that the discovery was an old one. The cases against the New Haven company and the National Electric & Construction company have never reached a final hearing and are still pending, but in the case of the Mather company a perpetual injunction was granted the Edison company on March 19, 1894, the court adjudging infringement and ordering an accounting from the Mather company.

The Milwaukee Arc Light company is alleged to have been illegally using the Edison patent since March 20, 1893, and it is alleged to have made great gains and profits. A perpetual injunction and an accounting is prayed for.

## Victory for the Milwaukee Street Railway Company.

The Milwaukee Street Railway company has scored a telling victory in its suit to set aside the assessment of $2,800,000 on the property of the company, including the road-bed and the franchises. In the Circuit Court for Dodge county, before which the case was taken by the city on the ground of prejudice on the part of Judge Johnson of the Milwaukee County Circuit Court, a decision has just been rendered which reduces the assessment by about $2,000,000, so that the assessment is now less than a third of its original size. After setting forth the facts, Judge Sloan continues that in a Fond du Lac case the Supreme Court had held that the franchises of a corporation were taxable, and that such would be regarded by him as the law, notwithstanding the vigorous dissent of Justice Orton when the Supreme Court rendered the opinion. Judge Sloan says:

In theory, then, the franchises of the relator are taxable. But when? Where? Upon what basis? Shall the taxation be as real or as personal property? Shall the assessment be where the power house is located or where the main office of the company is located? By what rule shall the value be ascertained? As a mere right to exist and to try to earn money the franchise is worth something, but its real value consists not in the right to earn, but in the fact that it can and does earn money.

How shall the value be estimated? Upon the capital stock, the net earnings, the market value of shares, dividends earned and paid, or any of the half dozen other rules that have been adopted in other states? None of these matters have been provided for by the Legislature, and until something more is done to provide the proper steps and machinery to assess and collect the tax, I must hold that franchises of corporations are not practically liable to assessment.

But, assuming otherwise, is there in the facts in this case, the testimony taken before the Board of Review, any warrant for the large increase of the warrant of the relator?

This court cannot interfere with the decision of the Board of Review merely upon the weight of evidence, or, stated in another form, because the court, upon conflicting evidence, would come to a different conclusion. There must be an entire absence of evidence to support the assessment before the court can interfere.

The whole question of assessing franchises is surrounded by difficulties. In their very nature they are to a great extent speculative and uncertain. The franchises of the relator have never before been assessed. The year 1894 was a year of unprecented depression and stagnation in business. The bonds of the relator have not been sold and have no market value. No dividends have been earned or paid on the stock. The earnings of the road have decreased as compared with the year 1893. The conditions engrafted upon the franchise have been in no wise diminished, but the cost of complying with them has increased. It is quite apparent from the testimony that the present value of the franchise is shadowy and nominal.

As against this condition of things, the only evidence to justify the assessment is the large price paid for the property at a time when business was booming and there was a craze upon the subject of electric railroads.

It would be as reasonable to assess the different mining franchises with which the country was flooded some years since at the fabulous prices at which they were bonded or stocked as now to assess the franchises of the Milwaukee street railway at the fanciful and exorbitant prices at which they were purchased. It would be at least prudent to wait until the railway developed ability to earn money before imposing additional burdens. The road is of immense value to the city and to its development and prosperity. It is, according to the evidence, a vexation and a burden to its owners. In the future the franchise may be valuable; in the present it is worthless; and until there is a change of conditions there is no warrant of law or equity for the proposed taxation.

The city will appeal the case to the Supreme Court.

## On Multiple Series Control of Motors on Small Electric Railways.[1]

By John Langton.

The only efficient method of controlling electric street cars is to vary the volts at the motors according to the speed required. The facility for doing this with storage batteries by means of grouping the batteries differently is one of the strong points of battery traction. In a trolley or conduit system with constant line pressure the same thing is arrived at by grouping the motors in series or in multiple. With only two motors to deal with, as in an ordinary street car, this makes rather an abrupt stop, which is eased off to a more gradual change by slowing them down by a resistance in series, or speeding them up by cutting out part of the field winding or shunting it by a resistance. This method was used in the early days of electric railroads, but was abandoned, not because it failed to give the results expected, but because it introdnced a new complication at a time when there were so many troubles with everything that simplification was the pressing need. These early difficulties having been surmounted, multiple series control has been successfnlly revived.

The figure usually accepted for traction on street railway tracks in average condition is 30 pounds pull on the drawbar per ton weight of car, moving on a straight and level track. To start the car from rest requires a much greater effort. Dynamometer experiments show a starting pull of from 90 pounds to 120 pounds per ton, equal to the traction needed for ascending grades of 3% to 4½%.

When the car is started with the motors in parallel, controlled by the simple process of massing in a rheostat the volts that are not needed at the motor terminals to give the amperes required for the traction, the demand on the station for power is greater when the car is being started than at any other time of its run, except on roads with heavy grades. But pntting the motors in series for starting greatly reduces the power required. The torque of the armature, which gives the traction, is a matter of amperes, and with the motors in séries the same traction is obtained with one-half the current required when the motors are in parallel. The power consumption from start to full speed is rather more than one-half, apparently because the accelerating force is more irregularly applied, so that it takes rather longer to get up to speed; or to put the same thing another way, in order to get up to speed in the same time, rather more than half the average amperes are needed for motors in series, as compared with motors in parallel. The actual figures seem to be about two-thirds the maximum power and two-thirds the total power consumption in starting and getting up to speed in the same length of time. This method of starting then takes a maximum current, which, if divided between the motors in parallel, would only give the traction needed for ascending grades of from 1% to 2%, and as almost every road has steeper grades than these, the heaviest power demand on the station comes, not from starting, but from moving up grade at full speed. But if we are content to go up such grades at a considerably reduced speed, we can get, as in starting, the necessary traction with half the amperes by putting the motors in series. The motors are then working with good efficiency on half the line volts and running at about half speed. There is of course no saving in the total power consumption—the energy; the car takes half as much current, but also takes twice the time to cover the distance. But there is a great reduction in the maximum power required, which would be about the same on a 5% grade with motors in series as on a 2% grade with motors in parallel, or about the same as the maximum power required for starting with motors in series. The motors must carry the same current in either case and must therefore be the same size, but the maximum demand on the power station from any one car is reduced nearly one-half.

On large roads the principle of averages may be relied on to a great extent, and the station capacity per car may approximate the average power taken by the car, but on small roads it is in general only safe to provide a station capacity per car of very near the maximum car demand. On small roads, therefore, a reduction of the latter means a reduction in size of station plant. Even if the average demand on a large station were appreciably affected by multiple series control, it could hardly be availed of. The most valuable reduction is that on grades, which may last for some minutes, while starting is a matter of a few seconds. But rapid transit is a principal reason of the existence of large electric roads and a prominent source of their income, and they can not afford to go slowly up hill For large roads the principal value of multiple series control is the ability to run slowly with good efficiency in crowded streets, and the saving of wear and tear on switch and rheostat at such times and at starting. On small roads with a few cars running on fifteen to twenty minutes headway it is more a question of communication than of continuously rapid transit; and, as has been shown, by sacrificing speed up hill a substantial reduction in the first cost of power plant may be achieved, without any sacrifice of ability to run at high speed on the level and low grades. The horse power hours drawn from the station would be the same per car trip in either case, but by easing off the starting current and slowing up on grades the power would be drawn more uniformly, with the tendency to reduce the variations of load on the steam engines. This should give better economy in steam consumption, but it is not at all probable that there would be any noticeable effect on the coal bill. The load diagram of the station would still be badly serrated, but the peaks of the diagram would be of more uniform height, and the highest of them lower than with motors always in parallel.

1 Read before the Canadian Electrical association, Montreal, September 19, 1894.

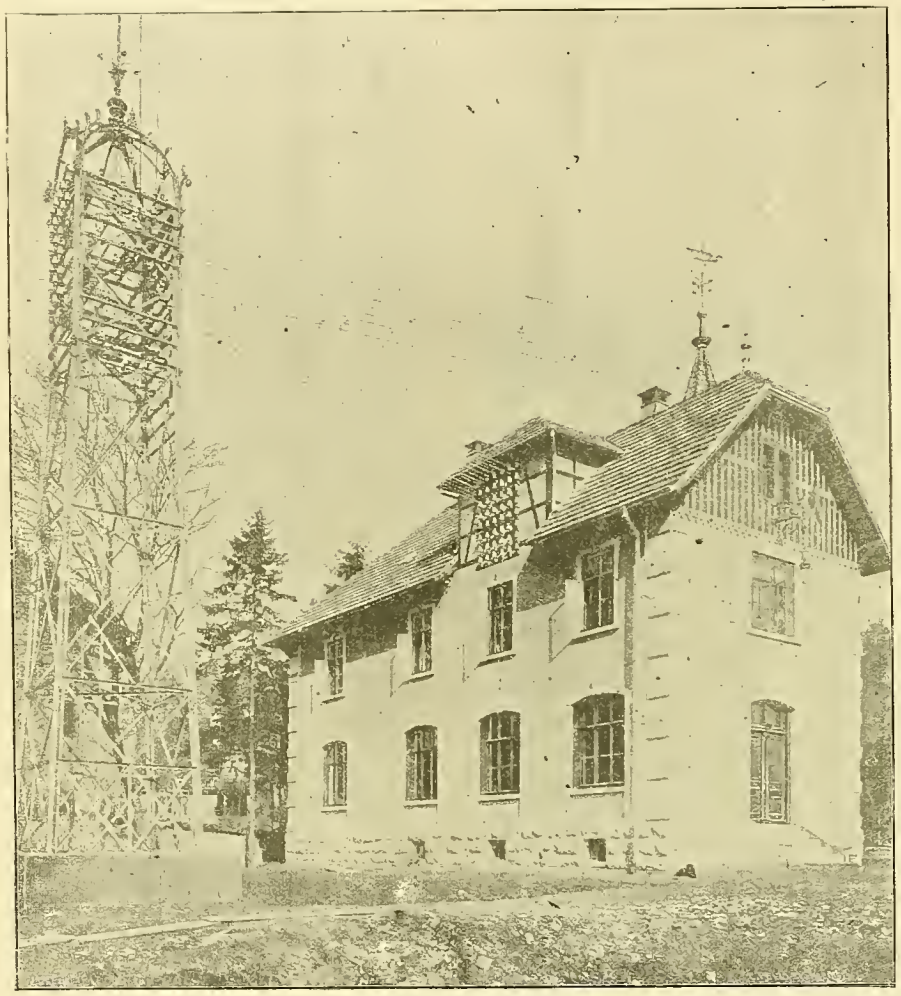


FIG. 3. ELECTRICAL POWER TRANSMISSION FROM LAUCHERTHAL TO SIGMARINGEN, GERMANY.

It is said that an electric railway, 300 miles long, is to b built, connecting Boise City and Lewiston, Idaho.

## Electricity Direct From Coal.[1]

The solution of this momentous problem has been discussed in a remarkably able manner by Dr. Ostwald, before the German Institute of Electrical Engineers. The science of electro-chemistry is just emerging as a distinct subject from the two sciences of chemistry and electricity. A great mass of facts are known, one-half of them belonging to the chemist and the other half to the electrician. The electro-chemist takes this knowledge, examines it with the eye of the chemist and also with the eye of the electrician, and gradually there is evolved the exact science of electro-chemistry. The great Faraday was an electro-chemist, and many of his most valuable discoveries are due to that fact; and the greatest problem now before the engineer, the chemist, the electrician, and physicist, namely, the generation of electricity direct from fuel, belongs to the science of electro-chemistry.

The ordinary galvanic battery generates electrical energy direct from fuel, but hitherto has the two fatal drawbacks of the necessity for the use of very expensive fuel, zinc and acid; and secondly, the difficulty of getting rid of the waste products immediately they are formed.

Not a little of the steam engineer's success is due to the delightfully simple methods and materials he employs. As a source of energy he uses coal, which is plentifully found ready for his use; this with air provides his heat in such abundance that he can afford to waste 90 per cent. of it and then generate electrical energy with his engine and dynamo much cheaper than the electrician can generate it direct from his fuels, zinc and prepared chemicals. Considering the immense amount of energy stored in coal, it is dirt cheap at usual prices; the air costs the engineer nothing, and, as a rule, water costs him next to nothing, and all three can be got without manufacturing almost anywhere in the habitable world. Then as for the waste products, those from the furnace take themselves off at once through the chimney, and the ashes and clinkers are also easily removed, while the exhaust steam flies into the atmosphere or condenser. In the galvanic cell the waste products accumulate and clog it, and the bigger the cell the worse becomes this trouble.

Dr. Ostwald suggests the use of the same elements by the electrician, which are so successfully used by the engineer, so that we may produce electricity direct from coal and air, the waste product being carbonic acid gas, which would itself escape, or which might be utilized. How such a cell or battery is to be made is as yet as great a mystery as ever, but Dr. Ostwald's remarks on the subject are worth perusing, and we give an abstract of his paper which deals with this part of the subject of electro-chemistry:

"The maximum of energy that can be obtained by any one change of energy is theoretically independent of the process by which the change is effected. Therefore, if we could transform into mechanical energy the chemical energy of the combustible without resorting to heat, we should not be tied then to the uncomfortably high temperatures, and might gain the entire amonnt without those discomforts.

"If we produce a galvanic element which furnishes electrical energy from coal and the oxygen of the air, and furnishes it in amounts somewhat in proportion to the theoretical values, then we shall face a technical revolution, in comparison with which the one following the invention of the steam engine will be dwarfed into insignificance. Think of the incomparably simple and elastic distribution of electric energy and imagine the change in the appearance of our industrial centers. No smoke, no soot, no boilers, no steam engines, nay, even no fire, for fire will be needed only in the few processes which cannot he accomplished by electricity, and of those there will he fewer every day.

"The energy of the galvanic element originates in the chemical energy; that is indnbitable. But not all chemical energy is changed into electrical energy. What, then, are the conditions for which the transformation is as complete as possible? Only the indirect chemical processes are electrically utilized.

"Suppose we should take two vessels containing each a solution of potassium sulphate and connected by a filled siphon. We put a rod of zinc into the one and a rod of platinum into the other vessel. If we connect the two metals over a galvanometer, a current of but very short duration occurs and the needle of the galvanometer comes directly to rest again. We know this to be the consequence of the polarization, and also know that a continuous current may be obtained by the employment of an acid in place of the neutral fluid. Snppose we employ sulphuric acid. Into which of the two vessels would you want me to pour it to produce a current? Whosoever had this question put to him unhesitatingly answered: to the zinc, of course, for the zinc must dissolve! But, my asking the question may convey the hint that the matter is different. We pour the acid to the zinc—no action! We pour it to the platinum, and we perceive the needle fly to the stop.

"We arrived thus at the seemingly absurd result that the acid must be poured into the vessel not containing the substance on which it is to act. That applies quite universally. Some years ago I published a long series of experiments which proved the validity of this principle for entirely different reactions. And that is by no means an nnforeseen or unexplainable fact, but the experiments were made because I had to expect the demonstrated phenomena from the theory which at that time was only just shaping, although at first blush they appeared scarcely plausible.

"But if we bestow some more thought npon the nature of these processes we soon perceive that they could not possibly take a different ceurse. If the zinc is to dissolve it must form ions, and to that end take up a certain quantity of positive electricity. To make this possible an even quantity of positive electricity must leave the solution, so that an equivalent quantity of hydrogen relinquishes its ionite existence and is transformed into common hydrogen. The discharge by the fluid of positive electricity cannot take place at the spot where zinc dissolves, for there the electricity is moving in the opposite direction. There is therefore no alternative but for hydrogen to escape at the cathode, conforming to the actual occurrence.

"The explanation plainly shows the futility of the proced-

1 From the London *Electrical Review*.

ure of the late Jablochkoff, when some years ago he tried to produce electrical energy from coal direct. He put the coal into melting niter, from which to obtain the oxygen, and the resulting violent combustion actually generated current, but so weak a one that it could not be utilized. Now we clearly perceive the reason of his failure: the niter does not belong with the oxidable electrode, but with one not attacked by oxygen. Surely in the Bunsen element we do not pour the nitric acid on the oxidable material, zinc, but on the coal, which under these conditions is not oxidable.

"Therefore, our future coal element will have the oxidizing medium on the side not containing the coal to be burned, and that medium must either be the oxygen of the air itself or some other oxidizing substance producible in quantities from the same. In its chemical process such an element would be like an ordinary stove. Coal is shoveled in at one side and oxygen admitted from the other; carbonic acid escapes as product of the reciprocal action. A suitable electrolyte has still to be added to bring about the electrical process. The electrolyte only acts as an interposed substance and will not be consumed."

## The Chloride Electrical Storage Battery.[1]

The Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, acting through its Committee on Science and the Arts, investigating the "Chloride Electrical Storage Battery," finds as follows:

The sub-committee appointed to conduct this investigation has had this battery under careful consideration for a number of months, and has investigated the several features which are claimed to give it merit. During the larger portion of the time a number of cells have been in possession of the committee, and have been placed upon a regular working circuit under the control of one of the committee's members, where they have been subjected to exactly the same usage as a number of other storage cells of other makers and of the same size, so that opportunity was thus given to obtain the results of the performance of the chloride storage battery in regular use, which is ultimately the final test by which the utility of all inventions and improvements must be measured.

The results of this examination have led to the opinion that this battery embodies certain features of construction which prove it, both theoretically and as verified by use, to be a distinct improvement over hitherto known forms of storage batteries. In order to fully appreciate these features of improvement, it will be necessary to recapitulate, briefly, a few well-known facts regarding storage batteries in general.

In all lead storage batteries, one of the objects desired is to obtain a large lead surface for small mass, as the capacity and discharge rates are strictly proportional to the amount of surface involved. This necessary maximum of surface has hitherto been obtained in one of two ways. The earlier way was to slowly eat out the lead plates by electrolysis until they had attained the requisite spongy condition, an affair of some time and expense. The later way—and the one which is generally practiced—is to cast a frame of lead, with raised right-angled ribs on each side, thus forming little depressed squares, or to punch a lead plate full of holes, which squares or holes are then filled with a pasty mixture of red oxide of lead in positive plates, and with litharge in negatives.

For several reasons cells made in this way have always given more or less trouble in service. In the first place, after continued use or during heavy discharges, a greater or less amount of mechanical disintegration of the positive plates would often take place, small fragments of lead and lead oxide dropping down between the positives and negatives, short-circuiting them and often causing further and more serious break-up, buckling and sulphating. Even when these particles are prevented from falling, their mechanical looseness causes poor contact with the supporting lead frame, thus entailing increased internal resistance and heating with diminished output. This disintegration appears to be due largely to the fact that the lead oxide paste placed in the holes, is a mechanical rather than a chemical mixture, and hence that in changing from $PbO_2$ to $PbSO_4$ during the action of the cell, the molecules being only related to one another in a fortuitous manner, are easily broken up and thrust apart in the change of volume attending the chemical action. This, of course, seriously limits the life of a battery, and its utility for public service.

In the chloride battery, it is claimed and the committee's investigations go to confirm the correctness of the claim, that the method of construction is such that this disintegration is far less liable to occur. This mode of construction is as follows:

Instead of cementing lead oxide paste into or against a lead-framing in order to obtain the necessary active material, the latter is obtained by a strictly chemical process. Lead chloride is taken, mixed with a given proportion of zinc chloride, and this mixture is then fused and cast in small squares in suitable moulds. When thus cast, the product is of whitish color and vitreous character, being quite brittle.

For the negative plates, these blocks are about ¾ inch square and $\frac{5}{16}$ inch thick, and are cast in groups of four, these groups being united by portions, having, say, $\frac{3}{32}$ to $\frac{1}{8}$ inch thickness. For positives, the fused mass is cast in separate lozenges, each lozenge having a beveled V-shaped periphery. These cut squares or lozenges are then placed in a suitable mould, and a molten mixture of lead and antimony, in proper proportions, is cast about them under high pressure, thus fixing them securely in a firm lead framing of somewhat more than the usual density (The feature of casting under pressure is an improvement in manufacture, due to H. Lloyd, who is connected with the American makers, and the process is protected by patents granted to him). The connecting sheets of the squares making up a group and the V-shaped bevel of the lozenge serve to make their solidity of fixation exceedingly good.

1. Report of the Committee on Science and the Arts on the invention of Clement Payen, Hall of the Franklin Institute, Philadelphia, March 29, 1894.

The frameworks containing the chloride castings are then placed in a dilute solution of zinc chloride, together with plates of zinc, the frames and zinc plates being alternated with one another and in metallic contact. This combination is the equivalent of a primary battery "dead short-circuited." The chemical reactions which occur, result in the removal of the zinc chloride and the chlorine of the lead and there remains finally the dense framing containing squares or lozenges of spongy lead, which plates are then "formed" in, practically, the usual manner.

If a section of the spongy lead thus made be examined, it is found that the metal is in a crystalline condition and that the crystals are all uniformly arranged with their longer axes perpendicular to the surface of the plate. This provides interstices, so that the changes of volume occurring in the chemical reactions of electrolysis, may take place without exerting lateral pressure upon the crystals, or otherwise crowding them into a condition of break-up. These crystals are not, of course, mechanically and irregularly bound together, but are related to one another according to the laws of molecular formation, and are, consequently, much more strongly bound together than if they had been mechanically combined.

Furthermore, this crystalline structure presents the maximum obtainable surface for the given mass an infinite number of inter-crystallic channels passing all through the material and the entire plate being of the same thoroughly spongy consistency, except in those small portions where the continuous lead framing is encountered.

The effect of this extreme porosity and surface area is to give the battery a maximum capacity for a given weight and size of cell, an item of great importance when considered with reference to the demands of traction. Very heavy discharges also can be taken from this battery, owing to the interstices between the crystals permitting changes of volume to occur without mechanical violence to the structure.

While the method of construction just described seems to accomplish its anti-disintegrating function perfectly, it has been thought best by the manufacturers, in order that there shall be no doubt about the matter, to introduce between the plates a thin sheet of acid-proof fabric, so that any small particles which might fall away, could not make metallic contact with two adjacent plates and thus short-circuit the cell. The fabric chosen for this purpose is woven asbestos cloth. It might be thought that the introduction of this asbestos would considerably increase the internal resistance of the cell, but the fact is otherwise, the resistance of the cell being not appreciably higher than that of other lead cells.

This is undoubtedly due to the fact that the larger part of the resistance of most lead cells is that caused by poor contact between the lead framing and the paste placed in it. In the chloride battery this contact is exceptionally good, owing to the pastilles of chloride being so firmly bound by the framing cast under pressure as to compensate for any resistance due to the asbestos.

These batteries are, and have been for several years, operating successfully and in very large numbers in the city of Paris as a source of current for lighting purposes. A large plant has been in operation in this city in a building of the Provident Life & Trust company for a year past, and a very large one has been installed at the station of the Germantown Electric Light company, where it is said to have given, thus far, entire satisfaction.

The manufacture of this battery is protected by a large number of patents of the United States and of foreign countries. The essential features of the process of manufacture, however, are covered by the patents granted to Clement Payen.

Believing that this battery is a noteworthy and meritorious improvement upon many other forms of lead battery, tending to greater durability, greater capacity without increase of weight, and making possible heavier discharges without injury, the Institute, therefore, recommends the award of the John Scott Legacy Premium and Medal to Clement Payen, the inventor.

## Telephone in the German Army.

An interesting military experiment between Berlin and Potsdam is described by a contemporary. A telephone line was laid on the march by two cavalry patrols, each consisting of an Uhlan officer and two Uhlan under officers; one starting from Berlin, the other from Potsdam, very early in the morning. Each patrol was furnished with a complete telephonic apparatus carried by one of the under officers, and a supply of steel wire wound on reels, each containing 1 kilometer of wire. The laying of the line began in Berlin in the following manner: The end of the wire was connected to the town circuits in Berlin, and the spool fixed on a carrier in such a way that the wire could unroll as the man rode along. A second man rode behind, furnished with a sort of fork on the end of his lance, making it about halt as long again; in this he caught the wire, and as they went along threw it into the upper branches of the trees lining the chaussée. Choosing roads furnished with trees, they rode along; the officer first, and behind the two men running the wire, about thirty paces apart. When the first bobbin was finished, they halted.

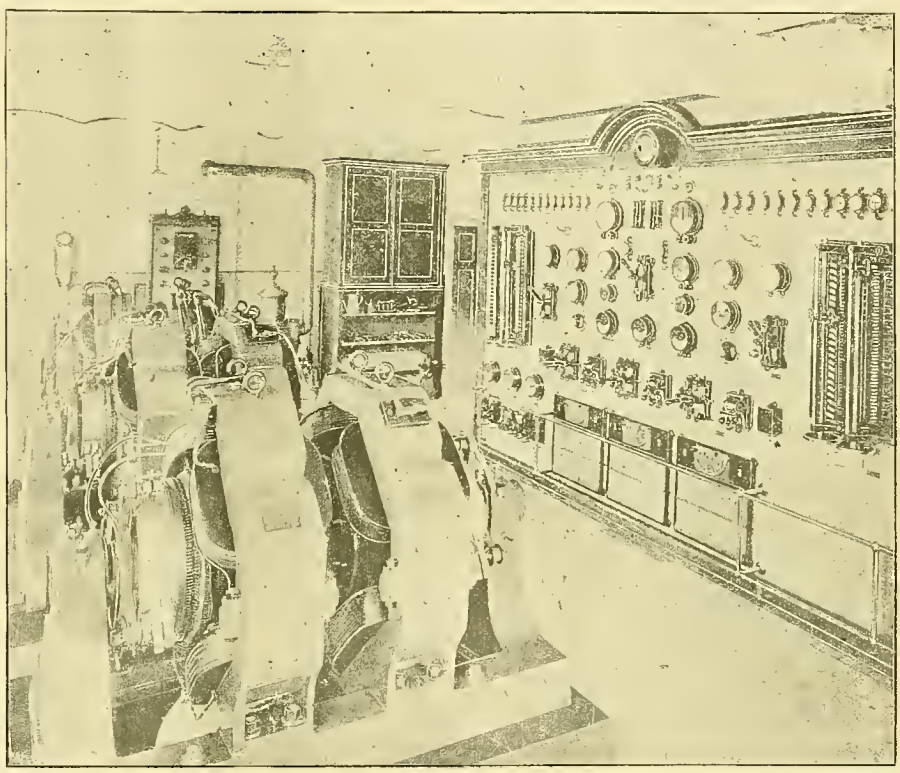


FIG. 4. ELECTRICAL POWER TRANSMISSION FROM LAUCHERTHAL TO SIGMARINGEN, GERMANY.

The telephone was connected, and a horn blown to signal to the starting point, a similar signal being the reply. Conversation having been held, the new bobbin was joined up and the process continued. At Teltow the two patrols met; the two ends were signaled, and then the wires joined together, and speech was excellent from Berlin to Potsdam. The order was then given to take up the circuit, which was done. The laying of the circuit of 30 kilometers took not more than four hours.

## Affairs of Taylor, Dee & Mack.

On Saturday last there was a meeting of the creditors of the firm of Taylor, Dee & Mack, Chicago, at which Mr. Taylor submitted a statement of the affairs of the concern. It was shown that the liabilities of the firm were about $13,000 and that the assets amounted to $7,000. This amount included all outstanding accounts, stock on hand, etc., and it was generally understood among the creditors that the actual assets would be much less than the figure mentioned. The stock on hand is estimated at about $1,500. Although the business of the firm has been practically conducted at a loss for some time, a committee of the creditors decided to recommend to the court as the wish of the majority that the business be continued in the name of the assignee for the benefit of the creditors, and it is generally believed that this policy will be finally adopted. F. S. Terry is the assignee.

## To the Convention.

The Big Four Route will run a special sleeper through to Atlanta, leaving Chicago at 8:30 P. M. Monday, October 15th, arriving in Atlanta at 6:00 A. M. October 17th. This is the only route from Chicago making connections in the Central depot, Cincinnati. For rates and sleeper reservations, address J. C. Tucker, G. N. A., 234 Clark street, Chicago

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IT appears that the storage battery litigation is to be continued indefinitely. Advices from New York announce that proceedings have been commenced which will probably extend over a prolonged period.

TWO cases are reported this week which will gratify every street railway man in the country. City officials in Milwaukee and Detroit have over-reached themselves and they have been plainly told by the court that street railway companies have rights and are not to be plundered by every demagogue who desires to gain cheap notoriety.

BY holding the convention of the American Street Railway association at Atlanta this year, it is hoped to arouse interest in the work of the organization among those engaged in street railway work in the South. There is an excellent field in that section, and much progress has already been made in introducing improved methods throughout the South, especially in Georgia. No doubt, there will be a large attendance at the meeting, and it is to be expected that many who have heretofore found it impossible to attend will be on hand at Atlanta.

THE figures given by Lieut. Hasson and Mr. Hunt, and printed on another page, showing the cost of installing and operating the electric lights and motors of the Midwinter Exposition at San Francisco are of much value, although it is to be regretted that the results were not more carefully tabulated. As Lieut. Hasson was chief of the electrical department and Mr. Hunt of the mechanical department, the statistics of operation may be regarded as official. The showing is a very good one indeed. With the results at the World's Fair, these figures will be of much importance to the electrical engineers of future exhibitions.

THE commanding position occupied by applied electricity in modern life is made manifest in many directions to the close observer by disinterested and unintended tribute. Thus the advertising columns of a New York daily newspaper contain the announcement of a prominent manufacturer of baking powder, which consists mainly of two cuts, one showing an incandescent lamp and the other a can of baking powder made by the advertiser. Under the former is the inscription, "The best light," while the other is styled "The best leaven." Over both is the heading "Up to Date," which completes the advertisement. The unchallenged superiority of the electric light in its field is thus made the standard of comparison for the advertiser's wares. The association is an odd one, but the unsought prominence given to the electric light is significant and pleasing.

ADVICES from Omaha indicate that an effort will soon be made to utilize the water power of the Platte and Elkhorn rivers. The press dispatches do not give very satisfactory information regarding the plans of the syndicate that is pushing the project. It appears, however, that the county commissioners are satisfied that the scheme is practicable, for they have decided to submit to the people a proposition to vote $1,000,000 subsidy to a company for the construction of a canal to bring the water power to Omaha. According to the dispatches, the design is to create a great water power just outside the city limits to be brought into the city in the shape of electrical energy and sold at a uniform price to all factories. The rates will be cheaper, it is announced, than the charge for water power in Minneapolis and other water power centers. The water is to be procured from the Platte river, forty miles from Omaha, and from the Elkhorn river, twenty miles away, and will be carried through a canal to a point near the city limits, where a fall amounting to 135 feet will be secured. At this point there will be developed 24,000 horse power. Here an electrical plant will be established, and the power developed will be brought into Omaha and distributed. The enterprise seems to meet with favor in Omaha.

A CURIOUS statement occurs in the opinion accompanying the decision of Judge Coxe of the United States Circuit Court, in the case of the Schuyler Electric company against the Electrical Engineering & Supply company. This was a patent infringement suit, in which the inventor conceded that his invention consisted solely in mechanical details for effecting improvements in circuit breakers. The judge considered that such an invention in any other art would probably be entitled to little consideration, and he added this observation: "But when the courts have to deal with patents relating to electricity they are apt to regard with superstitious awe the smallest contrivance by which that mysterious force is harnessed and set to work." This is indeed a strange admission, as it was styled by a Chicago journal devoted to legal matters. With all deference to the learned judge, however, we think that he underrates the technical knowledge of electrical apparatus which has been exhibited by his brethern of the federal courts in recent cases. Without invidious distinction and making due allowance for the able assistance of counsel and experts, it may be remarked that the opinions of the judges in nearly all of the electrical patent suits of the last few years have evinced a remarkably comprehensive knowledge of the phenomena of applied electricity. The day of "superstitious awe" of electricity in legal decisions is rapidly passing away, if it ever existed. We hope that the day is not far distant when the electrical features of every-day life will be regarded in a similarly common-sense manner by the public at large.

MUCH disappointment has been expressed in Detroit over the decision of the United States Court of Appeals in the case of the city against the local street railway company. This decision was handed down at Cincinnati on October 2d, and reversed the decree of Judge Taft, of the United States Circuit Court. It was a complete victory for the railway company, the court holding that the rights acquired by the corporation hold good for fourteen years. The effect of this decision on the street railway interests and the relations of the company to the city are subjects of considerable moment at this time. It is understood that the company is ready to proceed with improvements in its system, make considerable extensions to its lines, and introduce a complete electric system, but the city, through its officers, the mayor and aldermen, has exhibited a disposition to continue the fight against the company. Such a policy ought not to be tolerated by the people. Mayor Pingree has been allowed to have full play thus far, owing to the conviction of many business men that the railway company's title should be thoroughly tested, but now that it has been declared valid the "reformers," whose main object seems to be to keep themselves conspicuously before the public, should be called down and ordered to take back seats. It is now high time to proceed with the work of improving and extending existing lines and establishing new routes, which the company has all along announced itself ready to undertake as soon as it had assurance that litigation was over. Throughout the controversy the company has maintained a dignified bearing, in striking contrast to the attitude of Mayor Pingree and his supporters. Offers of compromise were made by the company before the decision was announced, but these were rejected by the city, as the mayor confidently looked for a victory. Now, that defeat has come, the city would, no doubt, gratefully accept the concessions proposed some time ago by the company, and there is no doubt that that corporation can well afford to effect a settlement on these terms.

THE same old arguments on the projected underground railway system of the Rapid Transit commission of New York are being presented by those interested in the measure, which will be submitted to the people for approval on November 6th. If the vote is favorable, the city is to be bonded to pay for the road; if it is unfavorable, the road must be built by private enterprise if it is built at all. On the plan of the Rapid Transit commission it would be an underground road, and a favorable vote, as the lawyers of the commissioners explain, would carry with it "approval of municipal construction according to the routes and plans already adopted," and also of "the construction, at the public expense, of any rapid transit railway which may be afterward approved by the board and consented to by the local authorities and others whose consent is demanded by the constitution." The subject has been pretty thoroughly canvassed by the commission, and it is believed that the plan submitted is the only practical scheme proposed which will afford permanent relief. At the last meeting of the commissioners, Chief Engineer Parsons, who was sent to Europe to study systems of rapid transit, reported that an underground railway could be safely constructed and could be operated economically by electricity. The atmosphere, he said, could be kept pure, and the tunnel could be well lighted. This, he was convinced, had been clearly proven by the experience already gained in this country and England. Mr. Parsons' conclusions are presented in the following abstract from his report: "The successful operation by electricity of the City and South London, the Liverpool Overhead and the Chicago Intramural railways shows that electrical traction has long since passed the experimental stage for service of this sort, and that this is not merely an opinion is further shown by the fact that the Baltimore & Ohio railroad is now building an electrical power house, and has ordered the construction of electrical locomotives weighing 95 tons each, which are to haul at regular service speed its large trains, both passenger and freight, through the tunnel recently completed under the city of Baltimore, and the further fact that the Metropolitan West Side railroad in Chicago will commence to operate its elevated railway by the same power in January next. To show how closely the cost of construction can be foretold, the preliminary estimates for the building of the Glasgow Central railway were £1,005,000, while the actual contracts amounted to £1,020,000, a variation of less than 1½ per cent." In view of this positive endorsement of electricity as a motive power, there can be no question of the system that will be adopted in case the plan of the commission is approved. Counsel for the commission report that in case of a vote adverse to the building of rapid transit routes by the city, the present commission will be relegated to the same helpless condition which prevented the old board from accomplishing anything. On the other hand, the desired result could undoubtedly be obtained if the city were empowered to construct the road. The road is to be at all times the property of the city. Under the provisions of the proposed act the road would be built by contract and equipped and operated by the contractor for a term of years at his own expense, the rental meantime going to pay interest upon the bonds which would be issued to pay for the construction, and the surplus, of not less than 1 per cent., to go into a sinking fund. The interest upon the bonds is not to exceed 3½ per cent. In all probability the vote on this measure will settle the question of rapid transit for New York. If the present plan is rejected it will be many years before a comprehensive system of rapid transit is provided for the people of New York.

## Cost of Light and Power for the California Midwinter International Exposition.

By W. F. C. Hasson and A. M. Hunt.

The following data concerning the California Exposition and the expense connected with furnishing the necessary light and power may be of interest:

| | |
|---|---|
| Area enclosed in the exposition grounds | 160 acres. |
| Length of roadways | 12,500 feet. |
| Number of buildings | 120 |
| Buildings supplied with electric light | 63 |
| Height of electric tower | 262 feet. |
| Dimensions of grand court | 1000 by 500 " |

Power was furnished for exposition purposes as follows:

| | |
|---|---|
| 56 | Arc lights for Mechanics arts building. |
| 141 | " " " Manufactures and liberal arts building. |
| 112 | Arc lights for horticultural and agricultural building. |
| 98 | Arc lights for Grand court. |
| 160 | " " " Roadways, etc. |
| 42 | " " " Patrol circuit. |
| 1,788 | Incandescent lights for exposition buildings and offices. |
| 2,256 | Incandescent lights for cornice lights. |
| 3,213 | " " " electric tower. |
| 1 | 60 inch search-light on electric tower. |
| 1 | 30 inch " " mechanics' arts building. |
| 19 | Small " for electric fountain |
| 3 | Pumps for electric fountain. |
| 2 | Pumps for statuary fountain. |
| | Line shafting. |
| | Fire pumps. |

| | |
|---|---|
| Incandescent lights furnished exposition | 7,256 |
| " " sold | 1,876 |
| Total incandescent lights | 9,132 |
| Ratio of total lights to lights sold, 4.86:1 | |
| Arc lights furnished exposition | 609 |
| " " sold | 182 |
| Total arc lights | 791 |
| Ratio of total lights to lights sold, 4.34:1 | |
| Receipts for sale of light and power | $26,279 |
| Charges per incandescent lamp—period of exposition | $ 8.00 |
| Charges per arc lamp—period of exposition | 75.00 |
| Period of operation—January 27 to July 9, 1894. | |
| Hours of incandescent light service | 1,937 |
| Days of arc light service | 154 |
| Number of electric fountain displays | 252 |

The machinery used for supplying power was as follows:

| | |
|---|---|
| 8 | Heine boilers of 375 H. P. each. |
| 1 | Russell engine driving 4 fifty light Thomson-Houston arc dynamos. |
| 1 | Buckeye engine driving 4 fifty light Thomson-Houston arc dynamos. |
| 1 | Payne engine driving 1 fifty light Standard arc dynamo. |
| 1 | N. Y. Safety engine driving 1 fifty and 1 sixty light Wood arc dynamos. |
| 1 | Ohmen engine driving 3 fifty light Standard arc dynamos. |
| 1 | Ball engine driving 2 fifty light Western Electric arc dynamos. |
| 1 | Thompson engine driving 1 fifty light Western electric arc dynamo. |
| 1 | Taylor-Beck engine driving 1 fifty light Western electric arc dynamo. |
| 1 | Hamilton-Corliss engine driving one 300 kilowatt Thomson-Houston alternating current generator. |
| 1 | Fitchburg-Corliss engine driving one 150 kilowatt Wood alternating current generator. |
| 1 | Union Iron Works engine driving two 150 kilowatt Western Electric direct current generators. |
| 1 | Thompson-Corliss engine driving one 150 kilowatt Edison direct current generator. |
| 1 | Hendy engine driving one 200 kilowatt Edison railway generator. |
| 1 | Putnam engine driving two centrifugal pumps for statuary fountain. |
| 2 | Hendy engines driving shafting. |
| 3 | Dow fire pumps. |
| 3 | Dow pumps for electric fountain. |
| 3 | Dow feed pumps. |
| 1 | Smith-Vaile feed pump. |
| 1 | 4,000 horse power Webster vacuum heater. |

The cost of material and labor for the installation of the machinery was as follows:

| | |
|---|---|
| Erection of boilers, pipes, pipe covering, etc. | $17,594.33 |
| Concrete foundation and foundation bolts for 14 engines and 6 pumps | 4,459.09 |
| Belting, shafting and sundries | 2,605.89 |
| Riggers | 573.00 |
| Office, wages and pay roll | 3,787.19 |
| | $29,019.50 |

Fountain construction, etc.—

ELECTRIC FOUNTAIN.

| | |
|---|---|
| Total expense for rental and installation of pumps, purchase and laying of pipes, all pump connections and construction of flume and tank | $13,692.72 |

STATUARY FOUNTAIN.

| | |
|---|---|
| Total expense for pipes, connections, etc. | 1,659.89 |
| | $15,352.61 |

WIRING.

| | |
|---|---|
| Three main buildings for 307 arc lights | $ 990.90 |
| For 2,160 exterior and 1,587 interior incandescent lights | 3,997.00 |
| | $ 4,987.90 |

RENTALS.

| | |
|---|---|
| Paid for use of boilers, engines, dynamos, wire, polehoods, etc. | $17,528.20 |

EXPENSE.

For material and labor of installation of electric plant:

| | |
|---|---|
| Wire | $ 6,056.92 |
| Sundry materials | 2,701.58 |
| Foundations for dynamos | 593.47 |
| Office, wages, salaries, etc | 5,709.40 |
| | $15,061.37 |

The cost of operation of the plant[1] from January 27 to July 9, 1894, was as follows:

ENGINES AND BOILERS.

| | |
|---|---|
| Coal, fuel oil and lubricating oil | $30,007.95 |
| Tools, supplies and repairs | 1,886.93 |
| Office, salaries and payrolls, engine plant | 13,680.50 |
| | $45,575.38 |

ELECTRIC PLANT.

| | |
|---|---|
| Carbons | $1,513.50 |
| Incandescent lamps | 2,072.20 |
| Tools, supplies, etc | 987.61 |
| | $ 4,573.31 |

SALARIES.

| | |
|---|---|
| Office | $ 717.00 |
| Inspection | 359.33 |
| Wages | 9,257.05 |
| | $10,333.38 |
| | $14,906.69 |

The following was provided for by special contract:

ELECTRIC FOUNTAIN.

| | |
|---|---|
| Contract for erection, rental and operation of same except splash basins, piping, pumps, etc., included in other statements | $21,000.00 |

ELECTRIC TOWER.

| | |
|---|---|
| Contract for rental of machinery, wiring of tower, operation of machinery and maintenance of lamps | $22,745.00 |

SEARCH-LIGHT.

| | |
|---|---|
| Erection of search-light | $87.50 |
| Material for operation | 67.05 |
| | $154.55 |

TOTAL EXPENSE OF INSTALLATION AND OPERATION.

| | |
|---|---|
| Installation of engine plant | $29,019.50 |
| Erection of fountains | 15,352.61 |
| Wiring contracts | 4,987.90 |
| Rentals | 17,528.20 |
| Installation of electric plant | 15,061.37 |
| Operation of engines and boilers | 45,575.38 |
| " " electric plant | 14,906.69 |
| Contract electric fountain | 21,000.00 |
| " " tower | 22,745.00 |
| Expense for search-light | 154.55 |
| | $186,331.20 |

The construction work of the electrical department, briefly stated, was as follows:

| | |
|---|---|
| Length of underground circuits installed | 17,560 feet. |
| Length of main pole line constructed | 9,000 " |
| Lamp poles for roadways, etc. | 371 |
| Incandescent lamps, wiring for | 1,800 |
| Total length of wire installed | 199,267 " |

The construction work of the mechanical department consisted of the unloading and handling of all machinery, the erection of all engines except two, the hanging of all shafting, the supervision of installation of all boilers, piping, and pumps for fountains, etc. The mechanical arts building was so poorly designed for the purpose for which it was used that considerable labor and expense was necessary to put it in proper condition. The chief of the engineering department was also chief of the department of mechanical arts, which added greatly to the office expenses of that department.

The exposition was located in a partially improved portion of Golden Gate Park. Three-fourths of the ground consisted of sandhills, on which were a few clumps of evergreens and a grove of young eucalyptus trees. The remaining fourth was swamp land, and was afterward converted into a recreation ground and plaza for fireworks and athletic and equestrian entertainments.

The citizens of San Francisco contributed $331,000 to the exposition fund. The original concession from the park commissioners was less than sixty acres. This grew to 160 acres, without a corresponding increase in subscriptions. Notwithstanding the fact that the exposition had no aid from the general government, state, county or city, not only were all obligations met, but a sufficient surplus remained to leave a large portion of the park permanently improved, and also a public museum and art gallery. Minute economy in every department was essential. Expensive underground construction was out of the question.

1. Includes all expenses for office, janitors, etc. connected with mechanics arts building.

The distance from the dynamo to the electric fountain was 460 feet. To carry the current for the fountain lights ten No. 0000 cables were necessary. The distance from dynamo to base of electric tower was 680 feet. To carry the current for the tower lights twelve No. 0000 cables were used. The duct for these underground cables was built of ordinary planks, the outside dimensions being 6 by 4 inches and the inside 4 by 2 inches. A continuous strip of P. & B. roofing paper was laid the entire length of the duct, the cables placed in position, the paper folded over and both edges secured in position by the cover of the duct. Although a large portion of the duct was under a lawn continuously saturated with water, no trouble what ever arose from this source. A large portion of the wire used was No. 0000 cable that had been in use at the World's Fair. This wire on removal was found to be in such excellent condition that it has been sold for interior wiring for 60 per cent. of its original cost.

The ducts for underground wires for arc lights consisted of 2 by 4 inch rough lumber, in which there was a 1 by 1 inch rabbet. Lamp poles were turned 8 inches in diameter at the base and 5 inches at the top; height 12 to 14 feet. Wires were carried in a groove that was closed with a fillet. Around the grand court, arc lamps were spaced 30 and 35 feet. On roadways, 50 and 75 feet.

For cornice lighting a 500 volt Edison railway generator was used. Lamps were wired in series of five and multiples of ten where the construction of the building would permit. Edison lamps were the ones used throughout. The wiring was so arranged that the lamps on buildings nearest the power station were 117 volts; those half way around the court 115 volts; and those most distant 113 volts. For all accessible places 16 candle power lamps were used. For places difficult of access, on domes and minarets, 20 and 24 candle power 120 volt lamps were used. This policy proved to be an excellent one, as the renewals in these places were merely nominal.

The wiring for the cornice lights was done by contract by the General Electric company. The sockets were in place several days before the lamps were placed in position. Through the carelessness of the inspector of wiring a great number of lamps were allowed to be placed in sockets partially filled with water. The first test of the decorative cornice lighting showed a dismal failure. The lamps were removed, sockets cleaned, and new lamps placed in position. Satisfactory results were obtained for a few days, when, after a heavy fog, a large number of lamps were found to be inoperative. Examination showed that in many cases the leading-in wires had been destroyed by electrolytic action. Lamps that were found to be in good condition were then thoroughly dried at a temperature of 300° Fahr. and the bases immersed in a bath of boiling paraffine. These lamps when placed in use withstood the weather perfectly, and the number of renewals became nominal.

The average daily load during the month of June was distributed as follows:

| | |
|---|---|
| Arc light machines | 2,156 H. P. hours |
| Alternating current incandescent machines | 2,462 " |
| Electric fountain generator | 2,805 " |
| Railway generator, light and power | 2,770 " |
| Generators for electric tower lights | 810 " |
| Fountain pumps, electric | 233 " |
| " " statuary | 480 " |
| Fire pumps | 600 " |
| Feed " | 442 " |
| Shafting | 160 " |
| Starting | 110 " |
| Total daily load | 13,026 " |
| Gallons of oil consumed per month | 130,200 |
| Gallons of oil consumed per day | 4,340 |
| Weight " " " | 32,116 lbs. |
| Weight of oil consumed per horse power hour | 2,465 " |
| Cost per lb. of oil at $1.75 per bbl | .56 ct. |
| Cost per indicated horse power per hour of engines | 1.3804 " |
| Percentage of load for incandescent lights | 28.2 per cent. |
| Cost of fuel for incandescent lighting per month | $1,520.99 |
| Cost of fuel per incandescent lamp per month | 16.5 cts. |

The cost per 16 candle power lamp for the period of the exposition was as follows:

| | |
|---|---|
| Freight on electric machinery | $ .40 |
| Installation of dynamos | .05 |
| Attendance of dynamos | .21 |
| Installation of wiring | 1.20 |
| Inspection of wiring | .05 |
| Patrol and maintenance of circuits | .03 |
| Lamps and renewals | .30 |
| Office expenses, electrical department | .06 |
| Total, electric department | $2.30 |

| | |
|---|---|
| Installation, engines, boilers, piping, belting and rentals | $1.32 |
| Fuel | .825 |
| Attendance, engines, boilers and pumps | .285 |
| Oil, waste, etc. | .01 |
| Office expenses, engineering department | .05 |
| Total, engineering department | $2.49 |
| Total expense of rental, installation, operation and maintenance of boilers, engines, piping, belting, dynamos, wiring, lamps, etc., per 16 candle power incandescent lamp for the period of the exposition | $4.79 |

In considering the cost of operation, it must he borne in mind that the lighting plant was in no sense well designed for economic operation. Both engines and dynamos were operative exhibits that had to be matched as well as circumstances would allow. The installation of all parts of the plant was attended with undue expense, on account of the chaotic condition of affairs incident to the necessarily rapid construction work of all departments of the exposition. The entire plant was of necessity regarded as an emergency plant, and so operated. The economic attendance of dynamos and engines was thus out of question. In making the preliminary estimates of the allowance to be made for cost of lighting plant, it was found impossible to get any figures of a plant under similar conditions except the contract for lighting the World's Fair.

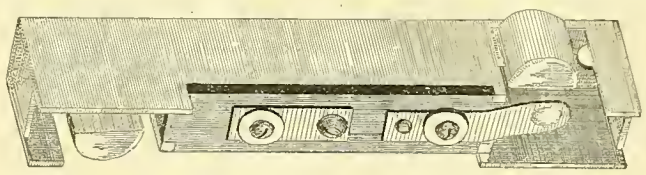
The results given in this article are those that were actually obtained, and it would appear that they should be of value in estimating the probable cost of work of similar nature. It is now certain that if all construction work had been done by the exposition forces, the cost of construction would have been reduced about 35 per cent.

## Improved Burglar Alarm Spring.

Hoggson & Co., 1 and 3 North Clark street, Chicago, have been pushing the sale of Hoggson's improved double window burglar alarm spring. The construction of the springs, as seen by the accompanying illustration, is simple. It is not necessary to remove either sash, stop-beads, inside blinds, or even curtains, to insert and connect them. They are accessible for adjustment or repairs by simply lowering the top sash, and they can be readily tested day or night without moving either sash. They have German silver cup-pointed contact springs, that clean themselves every time either sash is moved, insuring a good connection where the windows are seldom used. The insulating back is of hard rubber, to which is fastened the springs.

## Large & Twining Double Throw Switch.

Among the recent changes of Philadelphia firms which are engaged in manufacturing electrical supplies is that of N. S. Large & Son. The senior member, N. S. Large, withdrew from the firm and a new partnership was formed between the junior member, S. D. Large, and R. B. Twining, under the title of Large & Twining, with offices at 321 Chestnut street. Both members of the firm are well posted regarding the wants of the electrical trade, having spent several years in the mechanical construction of switches, etc. In the accompanying cut is shown one of the firm's new double-pole double-throw fuse switches, for which it is having many orders. This concern will also make a



IMPROVED BURGLAR ALARM SPRING.

specialty of high grade switchboards, models, repair and experimental work.

The knife switches manufactured by Large & Twining range from 10 to 10,000 amperes capacity, and are finished with much care. The entire polished work done by this firm is noticeable for finish and fit of contacts.

## New York Edison Illuminating Company Enjoined from Using the Chloride Accumulator

A special dispatch from Philadelphia asserts that the New York Edison Electrical Illuminating company was enjoined last Monday by Judge Lacombe from using chloride accumulators manufactured by the Electric Storage Battery company of Philadelphia, pronounced by him to be an infringement upon the Accumulator company's patents. The awarding of the contract by the New York Edison company to the Electric Storage Battery company was announced some time ago in this journal, and much interest centered in the proposed station, which was to have been the largest storage battery station in the country.

## The New A.-W. Arc Lamp.

The lamp shown in the accompanying illustrations and manufactured by the Auerbach-Woolverton Electric company, Broadway and Houston street, New York, is a wide departure from the usual form of arc lamps. The lamp complete measures but 18 inches from the top to the bottom, including the globe, and therefore is particularly adaptable to ornamental treatment. It is claimed that the carbons have a life of 25 hours in the open air. Owing to the disposition of the carbons, as seen in Fig. 1, the arc is constant in position, all the light is thrown toward the ground and there are no shadows whatever.

The only mechanism about the lamp, except the gravity feed, is that connected with the single magnet shown, and this is only used to strike the arc. The two positive and the two negative carbons are respectively held in two inclined frames, one of which is rigid and the other one hinged in order to enable the arc to be struck. The carbons are fed by gravity, each carbon holder being guided by two rods in the inclined frame. To insure uniformity of feeding the carbon holders of each pair are connected by levers pivoted to a central part, which slides along a guide rod as the carbons are fed; by this means each carbon of a pair is advanced at exactly the same rate. When out of circuit the carbons are in contact, but when the lamp is switched into circuit the central magnet shown strikes the arc. As the carbons are consumed they are fed down by gravity, the ends of the positives or the negatives respectively always being together, thus maintaining constant the distance between the positive pair and the negative pair. From this it will be seen that the magnet plays no part in feeding, its function in the high tension lamp illustrated being merely to strike the arc; in the low tension lamp, however, there is a regulating magnet. When the lamp is once adjusted no readjusting is required. As will be seen, the simplicity of the mechanism is remarkable and gives promise of tending to a very long life for the lamp. In Fig. 2 is shown the exterior appearance of one style of the lamp. No shadows are cast by this form of construction, and attention is particularly called to the fact that the globe is a perfect spark arrester.

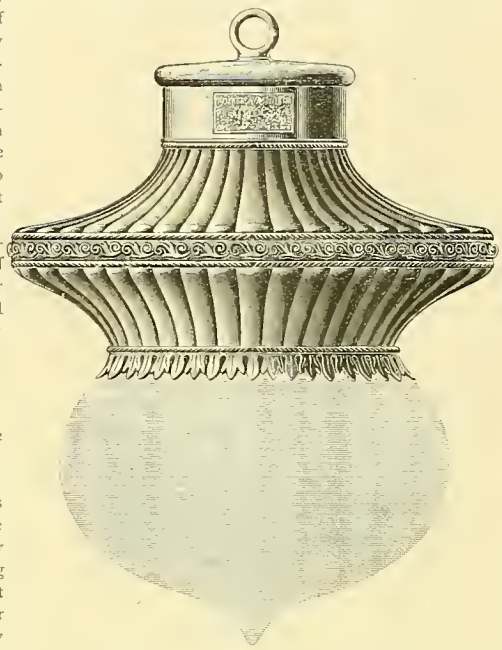
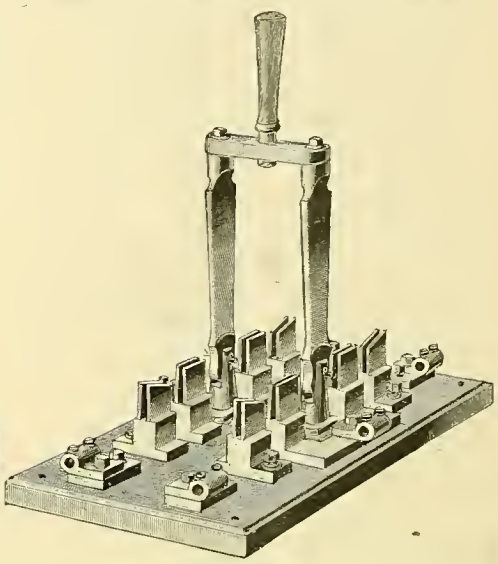


FIG. 2. THE NEW A.-W. ARC LAMP.

## Gas and Electric Light Conduits.

At the recent Congress of the Société Technique du Gaz en France at Nimes an account of an explosion of gas which occurred in the vicinity of some electric light cables was given by Gaston Gautier. The explosion took place in Nantes. The three-wire system is in use, the wires being naked and resting on porcelain supports. The branch wires are insulated. The contract under which the Electric Light company works compels it to put a cable under each footpath, except in narrow streets. The street in question had but one footpath, and only one main had been laid; and the branch which crossed the street was formed of two insulated wires, separated, and placed in a cast-iron conduit having lead joints. At the spot where the explosion seems to have originated a branch electrical service crossed the street in a cast-iron pipe about 3½ inches in diameter. The principal conduit having been uncovered at this point, it was found that the negative wire of the branch was broken at the entrance of the pipe. A trench opened in the direction of the pipe revealed right and left—about 16 inches on one side and 5 feet on the other—two lead pipes conveying gas into the neighboring houses. Each of these pipes was enclosed in a box made of deal, which had been steeped in sulphate of copper. But the vertical sides of one of these boxes had been sawn at a certain spot, doubtless to allow for deflection; and there was a rupture at the junction of the two parts of the other box, which made connection. It was precisely at these two places that large holes were found extending lengthwise along the pipe. Undoubtedly, a very considerable escape of gas took place through the perforations, and, following the line of wooden troughs, reached the electric light mains, and formed with the air contained therein an explosive mixture. The perforations must have been formed very quickly, and have preceded the explosion by only a short interval, as the openings were too large to have existed any length of time without giving indications of their presence by allowing a large escape of gas through the soil or in the consumer's house. It therefore appears reasonable to admit that the perforations were produced under the action of an electric short-circuit. As a result of this explosion the following regulations were agreed to: No work to be done by either of the companies in the vicinity of the mains of the other without due notice being given; the electric light company to substitute earthenware casings for those of cast-iron for its branch services, and branch gas service pipes, in the neighborhood of electric light mains, to be laid in wooden boxes into which there will be run natural bitumen.



LARGE & TWINING DOUBLE THROW SWITCH.

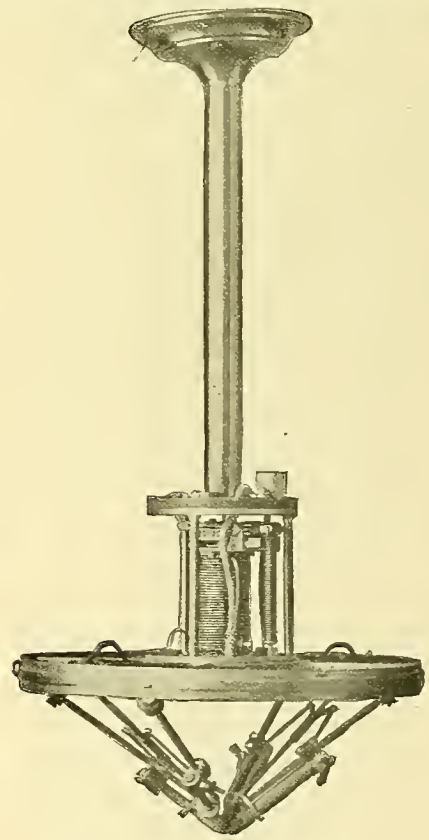


FIG. 1. THE NEW A.-W. ARC LAMP.

## Bliss Flexible Friction Clutch Pulleys.

The E. W. Bliss company, Brooklyn, N. Y., has lately secured the patent rights for the friction clutch pulleys shown in the accompanying illustrations, and has established a special plant for their manufacture. In Fig. 1 is presented a view of the clutch, and in Fig. 2 a sectional view of it. The special features of excellence which are claimed for this clutch are that it has a friction disk flexibly connected to the pulley, against the sides of which the clutch members grip; therefore, if the pulley wears out and ceases to be true on the shaft, no difference results in the operation of the clutch, no undue strains are brought on any of the parts, and no adjustments are necessary to compensate for this wear; that there are only two clutch members, one keyed rigidly to the shaft to which the levers are attached,

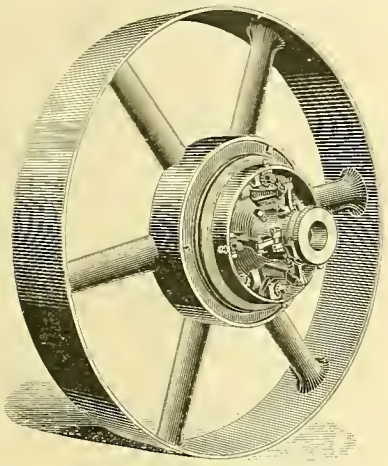


FIG. 1. BLISS FLEXIBLE FRICTION CLUTCH PULLEYS.

and the other movable, which makes the adjusting of the clutch a very simple matter; that the levers are so balanced that at any speed at which the clutch is run the centrifugal force has no tendency to throw the clutch in or out of operation. The clutch is constructed with very few parts, and is so put together that it cannot get out of order. Its clutching members are circular and concentric with the shaft, the only projecting parts being the levers, so that it not only presents a pleasing appearance when revolving on the shaft, but is in accurate balance, and may be run with safety at any reasonable speed. It is very compact, occupies but small space on the shaft, and is constructed in the best possible manner, with all parts interchangeable.

The company has a system of bushings for pulleys so arranged that if on account of long continued use, or where a poor quality of lubricant is used, the bore becomes worn, the bush can be returned and exchanged for one with a new

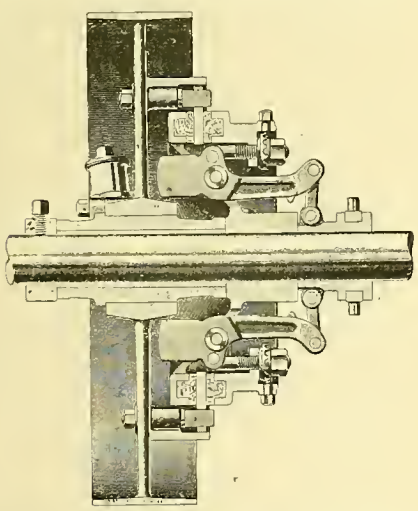


FIG. 2. BLISS FLEXIBLE FRICTION CLUTCH PULLEYS.

lining at small expense. The horse power which the different sizes of clutches will transmit is obtained from actual test by means of a dynamometer especially constructed for the purpose, and the company claims that the clutch attached to any pulley will transmit more power than can be transmitted by a double belt the full width of the pulley.

## Street Railway Convention Delegates.

The special sleepers with delegates to the street railway convention will leave Chicago at 8:30 P. M. Monday, October 15th, over the Big Four, Q. & C. & E. T. V. & G. route, arriving in Atlanta at 6:00 A. M. Wednesday. Reserve your berths at once. J. C. Tucker, G. N. A., 234 Clark street; telephone, Main 1482.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, October 8.—There is some prospect of a new telephone company being formed in this city to compete with the present company which controls the telephone service here. The idea of the projectors of the new company is to use the simple magneto telephone with some improvements. Experiments with the instrument since it has been perfected, it is said, have been satisfactory, and it is thought that there will be little trouble in introducing it here at figures far below those charged for rentals by the present company. The projectors of the new company assert that the telephone service as proposed in their plans will be given for $2 a month. The company has established an office in the Produce Exchange building, Dwight W. Curtis, a flour merchant, being the president. If the new company succeeds in placing before the public a telephone service for $2 a month there will be a general feeling of relief among the people of New York who have so long been subjected to the high terms of the company which now handles the telephone business in this city. The Metropolitan Telephone & Telegraph company has been without a competitor for so long a time that it has grown high in its rates and careless in its service. The new company proposes to give, besides a low rental, a first-class service in every respect.

The question of lighting Central Park by electricity was brought up at the meeting of the Park Board last week by the reading of a resolution passed by the Board of Aldermen on September 18th, calling upon the park commissioners to include in their departmental estimate for the year a sum sufficient to light Central Park. President Clausen said the matter required so much discussion that he did not wish to make any hasty estimate. They must first decide whether they would build their own subways and whether arc or incandescent lights would be used. Some persons were opposed to the lighting of Central Park, and others believed that electric wires would prove fatal to some of the birds, and all these points would have to be considered, he said. The matter was laid over.

An eel turned out all the lights that were burning in the Gerard Hotel on West Forty-fourth street at half past eight o'clock one morning last week. Of course, there were very few lights burning and those were in the engine room, but that wasn't the eel's fault. It did the best it could. Engineer Neenan hurried to the dynamo when the lights went out. He found that the belt of the engine that runs the dynamo was slipping uselessly over its pulley. Then he saw that the belt was wet. After a careful search he found that a steady stream was dripping from over the top of the Croton water meter. The water was turned off in the street and the meter was empty. When the last drop of water had dripped out, down came a fine, healthy, wriggling pale gray eel. It was immediately captured and put on exhibition.

A story comes from Newark, N. J., apparently well authenticated, that two horses were killed there recently by electricity escaping from its proper conductors and adopting gas and water pipes as its path. In this case both horses stepped upon a heap of iron pipes piled up upon the ground. Linemen from the Newark Electric Light Works said that the current must have escaped from an iron main pipe running through the alley, about a foot under ground, and that it might be that the electric light or trolley wire came in contact at some part of the city, and thus the current had passed to the drain pipes.

W. A. H. Bogardus, general manager of the Brooklyn Heights Railway company, which controls the principal trolley lines in Brooklyn, including all the branches of the Brooklyn City Railway company, has resigned his place, declaring that failing health was the reason. Cyrus P. Smith, the secretary and treasurer, also resigned. Mr. Bogardus takes Mr. Smith's place. One of the directors of the road asserts that there had been a reduction in the salaries of all the employes with the exception of the motormen and conductors, from the president down. The reductions, with other retrenchments recently made, would effect an annual saving of about $200,000. The directors announce that they have agreed to cut down the fee for attendance on meetings one-half.

The coming election has more than the usual significance to the people of this city, and the vote upon the rapid transit question will mean a great deal to the majority of the citizens, and for that reason an affirmative decision in favor of building a road in accordance with the act of the constitutional convention is anticipated. If the vote is unfavorable, rapid transit by city money must be abandoned, and the only hope will be a road by private capital. New York has been trying for years to get that, and, as everybody knows, the result is deplorable failure. The outlook for success in the future will be no more promising if the people should foolishly throw away the opportunity of getting municipal rapid transit.

Nearly all the street car lines in Newark, N. J., are now equipped with the trolley, and except on two small branch lines, the Mulberry street and Bergen street lines, the car horse has disappeared. The traction company has been short of closed cars and to accommodate the traffic has been using open cars. New closed cars are being received as soon as finished. About one-half of the electric cars are now equipped with patent fenders, and it is expected that all cars will be thus provided soon. The receipts of the traction company have steadily increased. The line recently built to connect Newark and Jersey City, which was regarded as a doubtful experiment, has proved a success and is now one of the most profitable branches of the system. It is in contemplation to use this line for the transportation of express packages and light freight from the Hudson to all points in East Jersey. Connection by trolley with Passaic, Paterson and other points north is now interrupted only by delay in constructing a link through Franklin township from Belleville to the Passaic county line. When this is completed a passenger can go by trolley from the ferry in Jersey City to Paterson with two changes of cars.

The "National School of Electricity" project of Prof. Barrett and Dr. Hornsby is being extensively exploited in this city. The language employed by some of the daily newspaper men in reference to it is rather extravagant, to say the least. Here is a sample from the pen of the New York correspondent of a prominent newspaper in the interior of the state:

The foundation of a national school of electricity, to be established in this city, is an honor for the metropolis and for the country. With Edison at the head of its faculty, and grouped around him the many able electricians who have came into note since the vast and rapid expansion of the science began, New York will possess a scientific institution which neither Paris nor London can rival. It will be among scientific institutions here what the Academie Francaise is among the other academies in Paris, the chief star in the constellation.

Following is the report in full of Chief Engineer Parsons, submitted at the last meeting of the Rapid Transit Commission. It is brief and greatly in favor of electric power and should carry great weight:

A rapid transit railroad in the city of New York, in order to meet the existing and future wants of the city and to possess the elements of financial success, must fulfill the following conditions:

It must be a line substantially constructed, capable of carrying heavy trains, with the means of running fast express trains, as well as local trains making conveniently frequent stops. The railway must extend from the Battery to the northern limits of the city, on both sides of the city, and must be located close to the main lines of travel.

Without expressing an opinion at this time on the merits of different systems, I may say: That an underground railway, if ultimately determined upon by the commission, can be safely constructed without endangering abutting buildings and that the cost can be determined in advance within reasonably narrow limits.

That such a railway can be economically operated by electricity, which power will move the trains as fast as can be done by a steam locomotive.

That an underground railway so operated will have a perfectly satisfactory atmosphere.

An underground railway, as suggested above, would not be like any railway tunnel in operation in this country. The atmosphere would be pure and clear, being entirely free from smoke, and the structure, by being designed, especially as to the stations, with architectural skill and being always well lighted, would be attractive in appearance.

During the last summer, under your instruction, I have examined, in addition to over forty miles of underground railway in operation, the construction of sixteen miles of such railways under some of the busiest streets in London, Glasgow and Paris, besides two large tunnels, one beneath the Thames and the other beneath the Clyde, the building of which is being done rapidly, securely and without serious delay to street travel.

The successful operation by electricity of the City & South London, the Liverpool Overhead and the Chicago Intramural railways shows that electrical traction has long since passed the experimental stage for service of this sort, and that this is not merely an opinion is further shown by the fact that the Baltimore & Ohio Railroad company is now building an electrical power house and has ordered the construction of electrical locomotives weighing 95 tons each, which are to haul at regular service speed, its large trains, both passenger and freight, through the tunnel recently completed under the city of Baltimore, and the further fact that the Metropolitan West Side Railroad company in Chicago will commence to operate its elevated railway by the same power in January next.

To show how closely the cost of construction can be foretold, the preliminary estimates for the building of the Glasgow Central railway were £1,005,000, while the actual contracts amounted to £1,020,000, a variation of less than one and one-half per cent.

The commission has already given instructions in regar to establishing an East Side route. No system of rapid transi would be complete which does not provide adequat facilities for this district, both above and below the Harler iver. At the present moment, since Madison avenue is debarred by statute, I am engaged in the study of this problem and will shortly lay before your board a full plan which will give to the residents of the East Side as complete accommodation as the plans already adopted provide for those on the West Side. W. F. O.

## Milwaukee, Wis.

MILWAUKEE, October 6.—City Clerk Anderson has heard from 58 cities in response to his inquiries on the subject of municipal electric lighting. Just half of the cities from which the city clerk received figures own their own electric light plants. The two cities in the whole list that most nearly resemble Milwaukee in size are Detroit and Montreal. Detroit has the contract system and pays $136 per lamp per year. The streets of Montreal are lighted by the municipality and the annual cost per lamp is $86. Detroit and Portland, Ore., are the only cities in the list that have conduits, and the lamps in those places burn 12 hours out of the 24. The annual cost per lamp in Portland is $112.56; at Valley Falls, Kan., $96, and at Marshall, Mo., $80. These three cities are lighted by the contract system. The cheapest lamps heard of are those of Clyde, O., where the annual cost per lamp is only $40. Clyde is a place of only 3,000 inhabitants. The average cost of electric lamps in the 29 cities and towns that own their own plants was $62.38, or 62 per cent. less than the present cost of electric lamps in Milwaukee. The city clerk reports that the facts which he has elicited correspond with the results of investigations made recently by Mayor Hopkins of Evansville, Ind., and by Springfield, Ill. Evansville received replies from 63 cities and Springfield from 41. It was found in these cases that the average cost of electric lamps in cities where the lighting is done by private contracts is $114.58, or $4 more than the present cost in Milwaukee. The average cost per lamp in 55 cities which do their own lighting was $57.88. These figures, it was stated, could be still further reduced by income derived from commercial lighting. In his report the city clerk calls attention to the inquiry conducted in Philadelphia. That investigation differed from the others in that no special inquiries were directed to other cities, the investigation being limited to the collection of expert and scientific opinions as to the cost of a plant. The recommendation, it will be remembered, was adverse to the proposition to engage in municipal lighting. In Milwaukee the matter still rests in the common council committee's box.

There was much surprise last week in legal and political circles when the city attorney filed an affidavit of prejudice in the case of the Milwaukee Street Railway company, which was seeking in the Circuit Court to set aside the assessment of $2,800,000 on the street railway plants, tracks, franchises and other property. Judge Johnson transferred the case to the Circuit Court of Waukesha county. Some days before the case had come up in court on a motion of the assistant city attorney for a continuance on account of the absence from the city of the city attorney. The counsel for the street railway company opposed the motion for a continuance. It was stated that ex-Senator Spooner of this state and William Nelson Cromwell of New York had come to the city for the purpose of presenting the company's side of the case to the court and that if a continuance were granted, they would rather have a long continuance than a short one, as the short delay would compel them to remain in the city until the case was called. The court granted a continuance from day to day.

Vice-president Henry C. Payne of the Milwaukee Street Railway company has returned from New York. It is learned that when he told the directors of the company of the action of the common council in taking steps ostensibly looking to the purchase of the street railway by the city they were highly amused and one of them compared the proceeding to a possible plan for buying corner lots in the moon. The directors of the company appear to be convinced that even if the common council is in earnest in regard to the matter it has no money for the purpose and would be prevented in any case by the terms of the charter.

The street railway tracks on First avenue are being torn up. The tracks were never used, and the people residing on the street and in the vicinity have been trying for two years to have the tracks removed. After an indignation meeting had been held and an ordinance calling for the removal of the tracks had been introduced in the council, the company sent word to the Board of Public Works that it would tear up the tracks. It is stated in behalf of the company that but for the hard times a First avenue street car line would now be in operation. The company is also tearing up tracks on upper Sixth street. On lower Sixth street the company is widening the street between Grand avenue and Clybourn street. The street is narrow and in order to get a franchise the company had to engage to widen the street at its own expense. Five feet of the curbing on each side is being converted into road.

The old Hinsey line cars are being rebuilt and will soon be put into service on the East Side line. New trucks are being placed under them and the roofs will be a foot higher than the roofs of the old cars. It is said that they will be among the best cars in the city. The work upon them is being done at the repair shops of the company.

The Fox River interurban electric line is attracting attention again. Mr. Tillotson, the projector of the line, was on the ground recently and attended a meeting of Appleton people, at which the matter of a franchise was discussed. He stated that his company was willing to accept the altered route and to build its own bridge at Appleton. The sense of the meeting was that a franchise should be granted, leaving the guarding of the city's interest to the common council. Mr. Tillotson satisfied the Appleton people that his company meant business.

It is claimed that Tillotson's Oshkosh franchise is not of value and that it will have to be passed again, as it should have been published in full two weeks before the common council took action upon it. The discovery that the law requires such a publication was made by agents of Tillotson who were trying to get a franchise at Kaukauna.

There has been a little electric railway fight at Menasha. An ordinance to give the Menasha & Neenah Electric Railway company a franchise was introduced in the council, whereupon Mayor Rosche took the floor and denounced the ordinance in unmeasured terms. The measure, he said, was designed to give the company the right of way, free and unlimited, over the streets of Menasha for a term of 35 years. He declared that the company had shown no evidence of good faith.

There is talk of building an electric line between Waukesha and Pewaukee. Waukesha men are backing the movement, and it is said that they have got options on terminal property. The plan is to issue stock to the amount of $20,000. C.

## PERSONAL.

F. Uppenborn has been succeeded in the editorial direction of the *Elektrotechnische Zeitschrift* of Berlin by Gisbert Kapp and J. H. West.

H. K. Gilman, formerly business manager of the Great Western Manufacturing company, Chicago, resigned his position last month on account of ill health. Mr. Gilman intends to take a trip abroad.

## NEW INCORPORATIONS.

Northern Electric company, Chicago, Ill.; capital stock, $25,000; George W. Furbeck, Chicago, Ill.

Cook Elevated Electric Railway company, Chicago, Ill.; capital stock, $10,000,000; Mark Sands, Chicago, Ill.

Mount Carroll Electric Light company, Mount Carroll, Ill.; capital stock, $12,800; Owen P. Miles, Mount Carroll, Ill.

Thompson-Brown Electric company, New York, N. Y.; capital stock, $25,000; to deal in electrical machinery, apparatus and supplies; Ernest Tayrault, New York, N. Y.

## ELECTRIC LIGHTING.

Proposals will probably be wanted for furnishing an electric light plant at Stephenville, Tex.

The electric light company of Palatka, Fla., has been granted a franchise to erect a plant in Palatka.

A movement is on foot for the organization of a company to establish an electric light plant at Ashland, Ky. A capital stock of $8,000 is proposed.

The directors of the Citizens' Electric Light & Power company, Springfield, Ill., held a meeting on October 3d and instructed the secretary to advertise for bids for a site on which to erect a plant, and for the fuel.

Two projects have been discussed for obtaining electric lighting at Fresno, Cal. One is to utilize the Clovis flume and build a power house at its outer fall, nine miles from Fresno, transmitting the power to the city by wire. The other is to dam the San Joaquin above Herndon, ten miles away, and utilize the water power thus secured.

## ELECTRIC RAILWAYS.

A franchise has been granted to H. E. Storrs for an electric railway at Los Angeles, Cal.

An electric road from Portland to Vernonia, Ore., a distance of fifty miles, is under consideration.

A suburban electric railway, nine miles long, is proposed at Tacoma, Wash. The cost is estimated at $40,000.

The Electric Railway & Park company, Lyons, Ia., has just been incorporated with a capital stock of $50,000.

The Metropolitan Railroad company of Kansas City, Mo., will build a new power house, put in new engines and an electric plant. George H. Nettleton of Kansas City can give information.

The new electric line on North Clark street, Chicago, north of Diversey avenue, has been opened permanently. The new electric cars will run as far north as Lawrence avenue, a point over six miles from the Court House. Transfers will be made from the Clark street line as before.

As a special west-bound freight train on the Wabash road was leaving St. Louis, October 4th, it crashed into and demolished a car of the Suburban Electric Street Railway company at Union avenue, in the western suburbs. The car was struck squarely on the front end and smashed into kindling wood. Six persons were seriously injured. Of these two women and the motorman will probably die.

The north branch of the Chicago river is to have a tunnel under it shortly at Roscoe boulevard large enough to carry electric power wires for the use of the Chicago North Shore Street Railroad company. The contract for the work has been given to Shailer & Schniglau, Rookery building.

The Cicero & Proviso Electric Street Railroad company applied to the Department of Public Works of Chicago, October 2d, for a permit to lay its tracks within the city limits, on Forty-eighth street from Lake street to Chicago avenue, and in Chicago avenue from Forty-eighth street to Fifty-second street. The permit was issued. The line is to pass through the north end of Austin and extend to Fifth avenue, Maywood.

Seven new motor cars have been received by the Chicago Electric Transit company for use on its line to be opened soon on Milwaukee avenue. They are Brownell acceleration cars. The new line will extend from Milwaukee avenue and Attrill street, the present terminus of the Milwaukee avenue cable road, six miles, and into Jefferson. The power house will be completed in October and the new line opened December 1st.

## MISCELLANEOUS.

*The Engineering Magazine* began in its October issue a new arrangement of its review of the technical press. Instead of devoting a particular department to the index of the most important articles published in the journals each month, the index of articles pertaining to its subject is now published at the end of each of the departments which have been made a feature of this magazine. Most of the principal technical journals in this country and abroad are indexed, and the whole forms a valuable feature.

A late addition to the class publications of Chicago is the *Business Law Weekly*, edited by J. L. Rosenberger. This journal is intended to supply information of current commercial law in language unobscured by legal terms. It is primarily intended for business men and contains much valuable matter in compact form. The editor has unusual facilities for obtaining the latest court decisions, and he is gifted with a ready discernment and the power of clear expression. The *Business Law Weekly* covers a new field and deserves success.

## TRADE NEWS.

W. J. Morrison, general agent for New York state for the Fort Wayne Electric Corporation, has resigned. Mr. Morrison is known east and west as one of the most popular salesmen in the electrical business and has been very successful in placing this well-known apparatus in nearly all of the large cities of New York state.

Edward Wertheim, 207 and 209 Lake street, Chicago, sole agent of the Union Carbon Works of Kronach, Germany, has received a most flattering report of tests of carbons made at the Armour Institute, in which the Union carbons made a remarkable showing. These carbons are particularly well adapted for use in alternating arc lamps.

The Electric Construction & Supply company of New York is flooded with orders for its standard Ward lamps, which it has offered to the trade at a reduced price. Only a few are left in stock. The lamp burns on a direct current of 110 volts. Those who have not placed their orders for lamps this fall can find a splendid assortment of arc lamps with this firm.

A. & J. M. Anderson of Boston, Mass., report an unusual rush of business during the last month. They manufacture a special line of trolleys and steel trolley poles, and all kinds of repair parts for trolleys are kept in stock, for which there has been a steady demand. The call for the Ætna railway insulators is fully as brisk as in the past, and an air of general prosperity is seen about their large factory.

J. H. Cooke, the western representative of the Buckeye special coiled filament lamp, says: "October trade has opened in a vigorous manner. Considering the splendid record the Buckeye 1 amp is maintaining for first-class illumination at low operating cost, our fair prices and the further important fact that the United States courts have decided that the Buckeye Electric company cannot be interfered with in the manufacture and sale of its lamps, the outlook for the coming season is encouraging."

The Metropolitan Electric company, Chicago, is the sole selling agent for the Gilliland Telephone company, which has been introducing the new Gilliland magneto telephone to the public. It is prepared to install telephone exchange plants, build short or long distance private lines, or equip hotels, factories, public buildings, stores, offices and resident apartments with telephone speaking tube systems complete. The company's set is of improved design and patent protection is assured. The Metropolitan company reports a large demand for the Gilliland instrument.

William J. Hammer, consulting electrical engineer, 26 Cortlandt street, New York, as shown by extracts from letters in his professional pamphlet, has had an extensive experience in various classes of electrical work during the last fifteen years in England, Germany, France and America. Mr. Hammer's business is to inspect and oversee the work of contractors, and thus insure satisfactory installations. In his present capacity he manufactures nothing and has nothing to sell; does no construction work himself, and accepts no commissions. He claims, therefore, the right to guarantee that his clients' interests will be carefully studied that he will secure for them the best systems or methods' high-class materials, excellent workmanship and careful supervision.

## BUSINESS.

The E. W. Bliss company has removed its Chicago office to 100–104 West Washington street, where it will continue to keep a representative line of presses, drop-hammers, shears and sheet metal machinery.

The Perkins Electric Switch company of Hartford, Conn., is preparing to move its factory into larger quarters, the present location being too small for its rapidly growing business. The company report a decided improvement of trade.

The Hart & Hegeman Manufacturing company of Hartford, Conn., reports that September was one of the largest months in amount of business done for a long time, and that the call is as strong as ever for its well-known Hart flush and snap switch.

R. D'Unger, manager of the D'Unger Long-distance Telephone company, Chicago, reports that Crookston, Minn., has been equipped with the D'Unger instrument, and that the subscribers of that place express great satisfaction at its operation.

With the return of short days the Boston Braid company of Boston, Mass., is rushed to supply its orders for incandescent lamp filaments to the large number of customers who have used its goods and proved their value. The company expects to shortly add to its plant, that the output may be materially increased.

Frank B. Rae, electrical engineer, Detroit, Mich., has just secured the engineering work for a municipal arc and incandescent plant for the village of Springville, Erie county, N. Y. Mr. Rae makes a specialty of electric railways, transmission of power, municipal lighting, and plans, specifications and general supervision.

The Electric Gas Lighting company of Boston, Mass., will close this year's business by a showing of a large increase in business. The company claims that it has been the most successful one financially since the organization. It has felt the depression but little, and a steady call has been made for its general line of supplies.

The chandelier switch manufactured by the Bryant Electric company is meeting with favor. The company has issued a neat circular illustrating this new specialty. Grier Bros., the western representatives of the Bryant Electric company, have a stock of these switches on hand in their Chicago storeroom in the Monadnock building.

The Beacon Vacuum Pump & Electrical company of Boston, Mass., finds that its business has increased to such an extent that with increased facilities for manufacturing it is pressed to keep pace with its orders. The company reports that prospects were never better in its line of business, and that a rapid increase is shown by the larger orders from firms whose orders were formerly smaller regarding quantity.

J. E. Lockwood has called a meeting of the creditors and stockholders of the Detroit Electrical Works to be held at the Telephone building, Detroit, Mich., October 15th, for the purpose of discussing the business of the concern, obtaining all the information possible regarding debts and accounts, and appointing an authorized committee to examine the property and assets and to formulate plans for a reorganization.

Eugene Munsell & Co., 218 Water street, New York, miners, importers and wholesale dealers in mica, having their presses and dies ready, are prepared to furnish mica stamped to exact pattern from the solid sheet for street car motors, rheostats and other purposes. They furnish stamped mica of special patterns, if purchasers will furnish their own dies, or they will have dies made and charge cost price for their construction.

Large & Twining, 321 Chestnut street, Philadelphia, have purchased the extensive plant of the late firm of N. S. Large & Son, and are prepared to fill orders for anything in the electrical supply line. The firm will use the best materials and employ only skilled mechanics, insuring a product first-class in every respect. The firm is getting out a catalogue of knife switches, which gives an excellent idea of them lie in this specialty which it is intended to carry.

The Washington Electric company, 197 South Canal street, Chicago, is pushing the sale of its well-known specialties and reports a number of satisfactory sales. The specialties made most prominent by this company include Meissner's improved focusing lamp, the Washington incandescent arc lamp for continuous and alternating currents, Meissner's Imperial rheostat, motor starting cylinders, special resistance devices of all kinds, annunciators, switches, plugs and receptacles.

The Electric Appliance company, Chicago, reports that it is "enjoying an excellent run of business at the present time, and things actually begin to look like old times and as though the long expected revival of business was upon us." This is, of course, to be somewhat expected just at the present season, but it is to be hoped that instead of the usual slump after the fall rush the increased demand caused by improving times will produce an increase in the volume of business even over what is now being done during the short busy season.

The Metropolitan Electric company, Chicago, has upon exhibition in its store on Fifth avenue a number of the Sweet limit switches, one of which was illustrated in the last issue of this journal. The company reports much interest in this device, and it will doubtless become a very popular addition to central station equipment. Large shipments of N. I. R. wire are being constantly made from the company's store and the wire is proving to be one of the most serviceable and popular in the market. The Metropolitan company's new catalogue, devoted to street railway supplies, is soon to appear, and will show the company to possess one of the most complete lines of railway supplies in the country.

President H. H. Eldred of the Columbia Telephone Manufacturing company, 136 Front street, New York, is showing a new improved telephone desk set, which is attracting much attention, and is of especial value for connecting various departments of large buildings used for manufacturing purposes. This concern has been pushed of late to fill its orders for regular telephones, and has recently moved into a new factory, thereby increasing its production three times over that of the old location. President Eldred will be remembered by the older telephone men of Chicago. He was in charge of the Bell telephone interests for the West, and the same push and energy shown while in that capacity is seen with the Columbia Telephone company.

The latest comer in the field of electric heating is the newly organized American Electrical Heater company of Detroit, Mich. This concern starts out with the following officers in management: Frederick H. Date, president; John Heffron, vice-president; Benjamin H. Scranton, secretary, and John Scudder, treasurer. The company has carried on quite a number of experiments, with Frank B. Rae as consulting engineer, and is now preparing an active exploitation of a novel electric soldering iron. The company's offices are at 9 Tolsma building, 45 State street, Detroit, Mich. Beside the soldering iron now ready for the market, this concern will shortly commence the introduction of a line of other heating novelities, and those interested in this branch of the electrical business will do well to open correspondence with the new company.

The American Tool & Machine company of Boston, Mass., although considered one of the most conservative firms in New England, as well as one of the oldest in its line, since the reorganization of the business staff, has shown unusual gains to its previous large business, which will shortly compel its removal to new quarters. President and General Manager E. C. Huxley is one of the best known mill men for construction work in the country. W. H. Hoffman, who was for a long time the general superintendent of the Buckeye Engine company, fills the same position with this company, and has the peculiar faculty of finding business at all points. In the selection of M. H. Barker as chief engineer, the company is to be congratulated. His work has always spoken for him—the best introduction one could ask. M. M. Whipple, superintendent of the sales department, is known too well among the electrical fraternity to need anything to be said of the large amount of work he will secure in this line, as he is one of Boston's most popular salesmen. The American Tool & Machine company is to push its business in the central and western states and there can be little doubt but that a good line of trade awaits it.

Word has been received from Secretary and Manager R. Humffreys-Roberts of the Fontaine Crossing & Electrical company, Detroit, Mich., to the effect that his company is now putting on the market a novelty in the line of dynamos. Without at present going into details it may be said that Mr. Robert's new departure is a double voltage dynamo, through which the consumer can take current at either 110 or 220 volts, and in any quantity up to the machine's rated capacity. In other words, this machine does, in a sense, the work of two dynamos, and it can be used on either the three or two-wire system. Those wishing further and more detailed information might do well to correspond with Mr. Roberts, as the applications of the new machine are numerous, and the many uses to which it may be put are surprising. Incidentally it may be said of the Fontaine Crossing & Electrical company that it has worked itself to the front in the electrical business in a manner that is, to say the least, highly gratifying to the projectors of the company. From the start Mr. R. Humffreys-Roberts has been at the helm, and with Rudolph Fuller as electrical and mechanical engineer the concern has achieved for itself an enviable reputation. In fact it makes the claim that not a single armature has ever been returned to the factory from a burnout due to defective workmanship. With this new machine the company proposes to branch out still more extensively and to establish agencies throughout the country. J. A. Campbell is now the company's western agent, with headquarters at room 33 Dexter building, 84 Adams street, Chicago.

Treasurer and General Manager Chas. C. Kritzer of the Sweet Electric & Manufacturing company, Grand Rapids, Mich., visited Chicago last week to make arrangements for the further introduction of his novel specialty. Mr. Kritzer deserves a great deal of credit for the energy he has displayed in so rapidly bringing his company to the front in the electrical field. The Sweet Electric & Manufacturing company is now organized with the following officers: D. Fred Sweet, president; Chas. C. Kritzer, treasurer and general manager; Chas. H. Annin, secretary, and Samuel Barnes, electrician. Mr. Kritzer has opened a factory at the corner of Louis and Campau streets, in Grand Rapids, and installed the very best machinery for the manufacture of the Sweet limit switch and the other electrical novelties which the concern is preparing to introduce to the electrical market. The success with which the Sweet limit switch has met has greatly encouraged the company. Although it has been on the market for a short time, orders have come from all over the United States, and those who have used the device write very flattering testimonials as to its value as a protective device for dynamo and motor circuits. The Sweet limit switch is made for alternating as well as continuous current service. From the engravings of the machine it is difficult to appreciate its best features and thoroughly efficient action. One of its strong points is the peculiar yet simple arrangement of its contacts, from which the arc is broken with a minimum flash and consequent burning; another strong point of the machine is the accuracy with which it may be adjusted so as to break the circuit at any given current strength.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued October 2, 1894.*

526,686. Electric Motor. John H. Clark, Boston, Mass. Application filed April 16, 1894.

The motor is especially designed for ventilators. The parts of the motor and its frame are compactly located adjacent to the blower, thereby economizing in space, and an extended hub of the casting serves to afford an additional and solid bearing for the shaft in carrying both the fan, the armature and the commutator.

526,704. Trolley Wire Hanger. John J. Green, Boonton, N. J. Application filed June 4, 1894.

The essential feature of the improvements relates to the device by which the trolley wire supporting mechanism is suspended by hanger or stretcher wires extending laterally across the path of the railway to posts or other supports; and the improvements consist of devices for supporting the mechanism which is made from sheet metal, struck up (in distinction to devices made by casting), and composed of interlocking or conjointly locking parts.

526,705. Trolley Spring. Julius L. Hanson, United States Army. Application filed May 14, 1892.

The invention consists of a compound or double spring made up of a pair of similar interlocking clasp springs, each of which is made of a piece of spring wire having two straight members connected by a spiral spring bend, acting as a torsion spring when the ends of the members are closed together.

526,720. Electric Winding and Setting Clock. Henry Loriot, New York, N. Y. Application filed October 3, 1893.

This invention consists in connecting a synchronizing magnet and the winding motor of a clock or series of clocks in circuit, so that they may be actuated by the same electric impulse. It also comprises certain improvements in synchronizing devices for clocks, whereby a prolonged impulse may be sent through the synchronizing magnet without stopping the clock.

526,721. Composition of Matter for Electric Conductors. Duncan Macfarlan, Philadelphia, Pa. Application filed May 16, 1894.

A baked conducting and resisting compound structure, composed of filamentous strands of asbestos, graphite and a binder, is described.

526,722. Composition of Matter for Electric Conductors. Duncan Macfarlan, Philadelphia, Pa. Application filed May 19, 1894.

A baked compound structure, consisting of graphite, clay, asphalt or coal tar, chloride of aluminum and a binder, is described.

526,723. Electric Igniting Apparatus for Fire Engines. William C. Matthias and Wilmer Hartman, Reading, Pa. Application filed October 2, 1893.

An electrical igniting apparatus adapted particularly for use in fire engine houses for the purpose of automatically lighting a fire under the engine boiler is patented. The purpose is to provide a simple apparatus by means of which the movement of the engine from its place in the house will turn on and instantaneously light a jet of gas; and when the engine has passed over it will automatically extinguish the flame.

526,725. Electric Snap Switch. Arnandus Metzger, Schenectady, N. Y. Application filed May 11, 1894.

The claim for novelty in this invention is based upon the combination with a handle and pivoted shaft, and a stop for the plug, secured to and vertically movable on the shaft, of a ratchet plug, loosely mounted to turn on the shaft, and spring contacts, the stop engaging the plug to operate the switch when the shaft is turned in one direction and permitting the shaft to be turned freely in the opposite direction without engaging the plug and not operating the switch.

526,736. Lightning Arrester. Fred S. Pearson, Boston, Mass. Application filed September 7, 1891.

The apparatus consists mainly in the combination of a lightning arrester with a switch controlled by an electro-magnet, the current between the electrodes of the arrester energizing the magnet which opens the switch and breaks the circuit, that is the main circuit, and also the branch circuit when a current is established through the electrodes of the arrester.

526,742. Commutator. Henry G. Reist, Schenectady, N. Y. Application filed June 28, 1894.

In the illustrations Fig. 1 is a section and Fig. 2 is a side elevation of the commutator, having a part of one end ring removed to show the construction. The method of assembling the parts is as follows: The commutator segments being put in place and properly insulated, the two end-ring sections, one on each end, embracing a suitable number of the segments, are put in place. The bolt $F$ is passed through the registering holes in the sections within the spider $O$. The nuts $G$ $G$ are then tightened so as to bring the end-ring sections against the face of the spider somewhat firmly. The wedge-shaped nuts $J$ are then inserted between the end-ring sections and the inner beveled face of the spider $O$, and the bolt head $I$ being turned, the end-ring section $C$ is forced toward the center of the commutator, thus drawing the commutator segments $D$ firmly into place, and this, as will be seen from the construction, without friction upon the insulation $E$, the strain being limited only by the crushing strength of the insulation. The bolt $F$ is then made tight. As will be seen in Fig. 1, the outer face of the end-ring sections adjacent to the commutator segments is cut away at $C'$, and these ends of the commutator segments are insulated from the end-rings at this point by wrapping twine, several layers in thickness. When the twine is wrapped around sufficiently to present an even surface, a sheet $C^2$ of leatheroid, or other tough insulating material, is interposed, and a further wrapping of the twine fills up the cavity to an even finish.

526,743. Dynamo-electric Machine. Edwin W. Rice, Jr., Swampscott, Mass. Application filed February 28, 1894.

The invention consists in a method of eliminating the back or counter-electromotive force of a part of coils connected in series and revolving in a magnetic field, by so arranging the angular distance which they cover upon the armature with relation to the angular space covered by the field magnet poles that the total flux of magnetic force will at certain times in the revolution be included by the coils, or coincidently pass through the axes of the coils in its entirety, or practically so. The elementary form is shown in the illustration, where $N$ $S$ are field mag-

net poles and C C' are the coils forming the winding of the armature. They are displaced 60 degrees, wound in the same direction and connected by the conductor *d*.

526,756. Trolley Guard. Henry J. Tanner, Lynn, Mass. Application filed April 2, 1894.

There is described in a trolley head the combination with a trolley wheel of a yoke extended beyond the axle of the trolley wheel at an angle of about 20 degrees with the line of the trolley arm, and having a notch formed in each of its upper extremities, a spring on each side of and secured to the yoke, an arbor fastened to each spring and passing through the notches

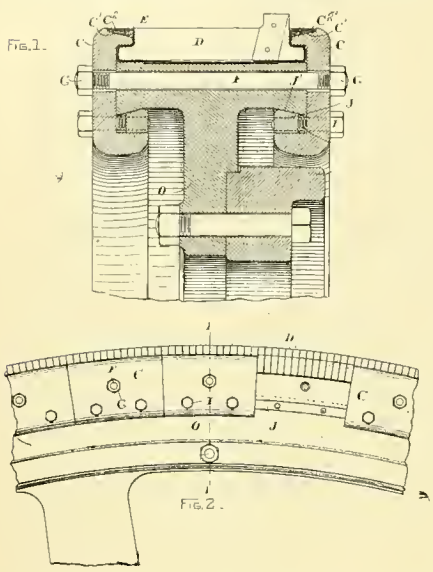


FIG. 1.



FIG. 2.

NO. 526,742.

formed in the extremities of the yoke at an angle with the plane of the trolley wheel, and a ball or wheel on each arbor adapted to rotate thereon, the balls or wheels meeting above and in the center plane of the trolley wheel.

526,760. Electric Alarm Operating Mechanism. Parker C. Thompson, Elmira, N. Y. Application filed December 19, 1893.

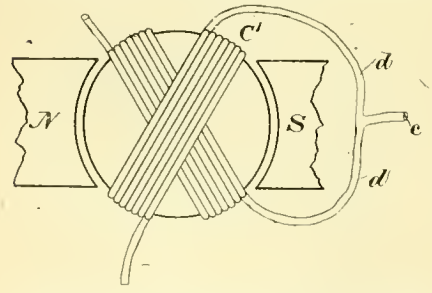
The apparatus consists of a device for sounding an electric alarm and automatically interrupting it after the lapse of a suitable length of time.

526,767. Electric Railway Conduit. Robert B. Wilson, Cincinnati, O. Application filed January 2, 1894.

The invention consists in part of a conduit having a projecting or flanged base, upon which it rests and by which it is secured to the ties of a railway, the conduit being made up of sections, each section having an incut or a socket at one end and a reduced portion at the other, the socket of each section being entered by the reduced portion of another, and the reduced portion of one section fitting the socket of the next.

526,810. Apparatus for Putting Electric Motors Into Circuit. Carl Hoffman, Charlottenburg, Germany. Application filed October 29, 1892.

The illustration shows in diagram the regulating apparatus, coupled in circuit with an electric generator and motor. As soon as the switch 22 is closed, a current which is greater than that normally used for operating a motor is transmitted to the magnet 24, in consequence of which the magnet attracts its armature and lifts the carbon 26 from contact with the carbon 28. Before this can take place, however, a current impulse has been transmitted to the motor 21, and this impulse acts to set the motor in motion. When the magnet 24 attracts its armature the current through the apparatus is interrupted, the magnet allows its armature to fall, and the carbons 26 and 28 are again brought into contact, a new impulse is transmitted to the motor, and the magnet again attracts its armature and separates the carbons from each other. This action of the magnet, that is, allowing the carbons to come into contact and then separating them, is repeated until the motor has obtained ap-




NO. 526,743.

proximately its normal speed, and thus generates a sufficient counter-electromotive force to cut down the current transmitted from the generator to the normal current used in the motor. When this point is reached the magnet 24 is not sufficiently magnetized to enable it to separate the carbons 26 and 28. Instead of adapting the magnet 24 to entirely separate the carbons when the current is first turned on, approximately the same object will be attained if the carbons are only so far separated as to permit a considerable arc to be formed between them, which separation should be sufficient to bring about the desired modification in the transmitted current. When this latter scheme is adopted the length of the arc will decrease as the counter-electromotive force from the motor is increased, until the point is reached where the motor is generating its maximum counter-electromotive force, when the two carbons will be in contact.

526,825. Electric Lamp Hanger. William S. Weston, Chicago, Ill. Application filed January 13, 1894.

The object of the invention is to produce an electric lamp hanger of a simple, efficient and durable construction, whereby the lamp may be retained suspended in any desired position, which will operate automatically to arrest the descent of the lamp in case of accident, such, for example, as the breaking of the hand rope or the accidental letting go of the same by the operator, and which may be easily and conveniently operated, and wherein also the lamp and electric connections are properly insulated from the hanger board and ceiling or supports to which the hanger is attached, and wherein also the two electric terminals on or in the body of the drum are properly insulated from each other.

526,835. Conduit Railway Trolley. Robert J. Hewett, St. Louis, Mo. Application filed February 9, 1894.

One of the features of the invention is a conduit collector provided with a pivoted support mounted on the vehicle to admit movement in vertical and horizontal planes, a detachable plow capable of dropping within the conduit connected thereto, detachable connections for the motor leads and means for sustaining the pivoted support when the plow is disconnected.

526,850. Conductor Switch. George H. Benjamin, New York, N. Y. Application filed September 28, 1893.

The invention consists in providing the working conductors, which in this case are centrally disposed contact rails mounted on insulating supports, with removable crossing sections, and in the arrangement of special operating apparatus therefor.

526,865. Telephone. Hosea W. Libbey, Boston, Mass. Application filed August 1, 1892.

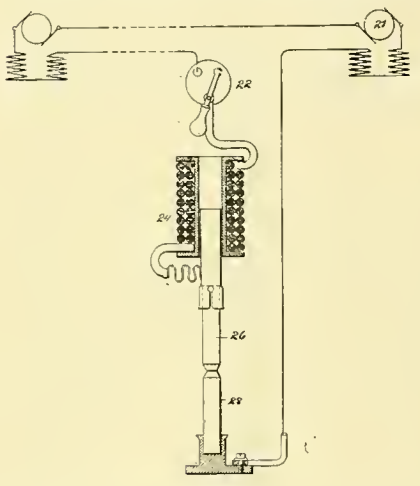
There is combined in a telephone a box or case inclosing an armature arranged between the poles of a horseshoe magnet and the diaphragm, the armature being suspended by catgut and surrounded by sponge or its equivalent saturated or filled with suitable material.

526,867. Rheostat. Duncan Macfarlan, Philadelphia, Pa. Application filed May 18, 1894.

The invention is a rheostat, comprising a homogeneous baked composition structure for controlling or adjusting the voltage of an electric circuit and provided with pin contacts, conductors from a source of energy in connection with the structure, and a switch adapted to be manipulated in the path of the contacts.

526,879. Dynamo Regulator. John Van Vleck, New York, N. Y. Application filed May 31, 1894.

The invention consists first in the peculiar construction of the regulator; second, in the arrangement of several regulators to form a multiple regulator occupying relatively small floor space, and, third, in the arrangement of the resistances in combination with such a regulator at a distance therefrom.




NO. 526,810.

526,888. Transmitter for Telephones. Mark O. Anthony, Cincinnati, O. Application filed July 28, 1894.

A front view of one form of an improved transmitter is shown. *A* represents the supporting plate or diaphragm, *b*, *c*, *d* and *e* carbon blocks secured thereto, *f*, *g*, *h* and *i* a series of carbon pencils mounted in the blocks, *j* a carbon pencil having its bearings in pencils *f* and *i*, *j'* a carbon pencil having its bearings in pencils *g* and *h*, and *k* a carbon pencil having its bearings in the transverse pencils *j* and *j'*. It will be seen that pencils *f* and *i* and *g* and *h* are locked against rotation by the transverse pencils *j* and *j'*, which are in turn locked against rotation by pencil *k*.

526,893. Fire Alarm Telegraph System. William E. Decrow, Boston, Mass. Application filed March 13, 1893.

The combination with a central station and a local station, of a circuit connecting them, a series of circuits extending from the local station, and a switch placed at a point outside the local station for disconnecting the lines therefrom, and connecting them in series with the central station, is claimed as novel.

526,897. Electric Railway Trolley. Robert A. Grant, Providence, R. I. Application filed January 22, 1894.

The invention consists in supporting the trolley wheel in cheek pieces or in a frame pivotally connected with the free end of the trolley mast, and in means for holding the trolley wheel in contact with the trolley wire during any vibration of the free end of the trolley mast. It also consists in the peculiar and novel arrangement of the guard wires or arms in connection with the pivoted support in which the trolley wheel is journaled.

526,909. Electric Lock. Theodore P. Platt, Boston, Mass. Application filed May 7, 1894.

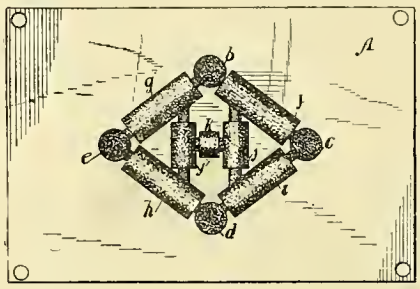
One claim comprises in an electric door opener the combination of a casing having a bolt-receiving recess in its face plate, a spring-held pivotal keeper adapted to extend across the recess and confine a latch-bolt therein, an electro-magnet, a spring-held armature therefor constituting a detent, a pivoted arm arranged to be locked by the detent against movement in one direction, a pivotal bar engaged at one end with the arm and arranged to bear at its opposite end against a part of the keeper, and a resetting bell crank lever, one arm of which extends in the path of a part of the keeper and the other arm of which coacts with the pivotal-locking bar and the detent-engaging arm.

526,963. Conduit for Electric Railways. Michel Angelo Cattori, Rome, Italy. Application filed April 3, 1894.

The invention consists in part of the combination with two corresponding adjacent sections of each of the conductors of a rotatable circuit closer having a surface made partly of an insulating and partly of a conducting material, and stationary contact pieces adapted for continuous sliding contact with the surface of the circuit closer, and connected to the adjacent sections of the conductors, the contact pieces and the insulating and conducting portions of the circuit closer being so arranged relatively to each other that the adjacent sections of one conductor are connected when the corresponding sections of the other conductor are disconnected, and vice versa.

526,965. Combined Telegraph Key and Sounder. Philip D. Cox, Jasper, Fla. Application filed January 9, 1894.

The combination with a base and key of a threaded stud inserted in the base and extending through a hole in the key, nuts placed on the stud, and a spring resting on the nut and pressing the under surface of the key forms the basis for the application.




NO. 526,888.

526,966. Electric Friction Brake. Bergen Davis, Newark, N. J. Application filed March 28, 1894.

The invention consists in part of the combination with a magnetized drum consisting of a periphery composed of pole pieces separated from one another by diamagnetic material and electro-magnets connected with the pole pieces, having consecutive pole pieces of opposite polarity, of a metallic strap or shoe held for attraction to and for frictional engagement with the drum, the drum being adapted to be revolved.

526,982. Magneto Call Bell. Joseph B. Smith, Manchester, N. H. Application filed April 27, 1894.

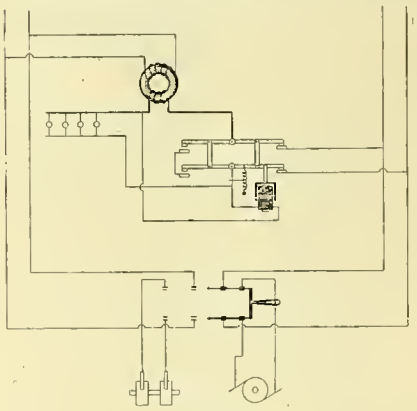
A magneto call device for telephones is described, consisting of a magneto machine having a rotary and longitudinally movable armature shaft, a crank shaft, gearing intermediate to the armature shaft, and a crank shaft for imparting the longitudinal movement to the armature shaft during its rotation, the armature shaft being adapted when rotated to break the circuit and cut in the armature of the magneto generator, and a spring for returning the armature shaft to its normal position when at rest.

526,988. Electric Switch. Frank G. Beron, Waterbury, Conn. Application filed June 21, 1894.

The invention has for its object to provide a double-pole electric snap switch which shall be adapted for general use, but especially adapted for attachment near the ceiling of a room and to be operated by a chain or cord, whereby the additional wiring required where switches are placed in position to be operated by hand is wholly avoided.

526,992. Combined System of Alternating and Direct Current Distribution. Albert L. Clough, Manchester, N. H. Application filed May 15, 1894.

It is the intention of this invention to provide apparatus to avoid the loss from hysteresis and eddy currents in the iron of the transformers of an alternating system of distribution. Although the method makes use of a pair of extra wires for the supply of the direct current, the amount of current called for during the time when they are in use is so inconsiderable that their cross-section need be but small. The system consists, as seen by the illustration, of the combination of a source of direct and of alternating currents of conductors for the distribution of these currents, of branches to connect the translating devices to the direct current mains, of transformers having their primaries connected to the alternating current mains, and each having its secondary included in one side of its appropriate branch, and of devices to short-circuit the direct current mains when the alternating current is on, and to remove the short-circuit when the alternating current is off.



NO. 526,992.

527,023. Differentially Geared Electric Motor. Benjamin C. Pole, Deanewood, D. C. Application filed November 12, 1892.

The operation of the invention is as follows: Upon the electric current being turned onto the motor, the armature shaft commences to revolve, and with it a pinion wheel. This wheel intergears with a non-revolvable wheel and causes the armature, field magnets and frame to all revolve around with and together with the main shaft, and give to the motor the vantage point of leverage for it to do its work with.

527,034. Scale and Index for Electrical Measuring Instruments. Edward Weston, Newark, N. J. Application filed March 15, 1894.

The object of this invention is to provide a scale and index needle for an electrical measuring instrument, which can be read when the observer is standing at the side of the instrument as well as when he is placed directly in front of it.

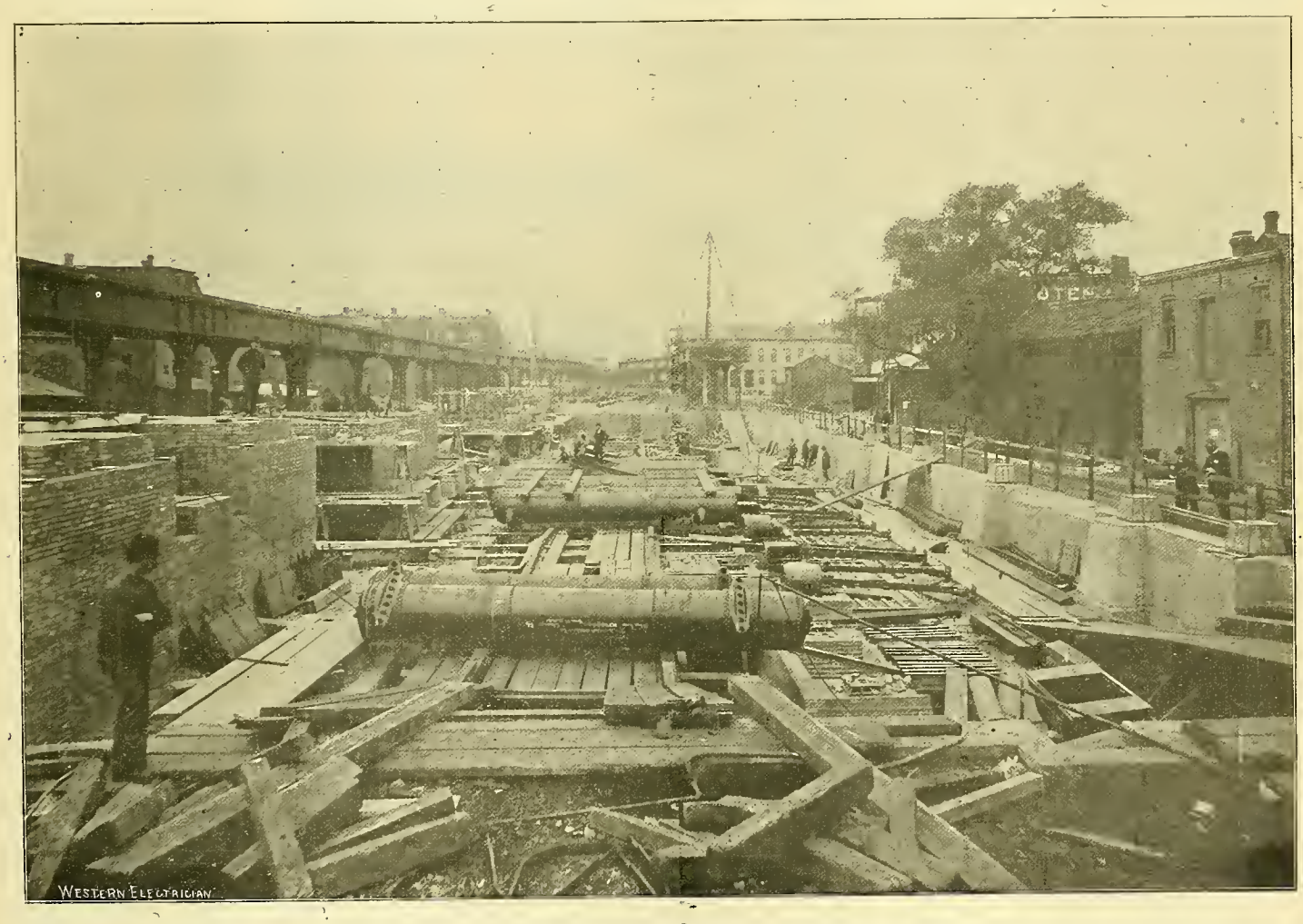
# Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, OCTOBER 20, 1894. No. 16


## Power House for the Metropolitan Elevated Electric Railway, Chicago.

The picture herewith presented represents the present stage of coostruction of the power house for the first all-elevated electric railroad in the country—the Metropolitan of Chicago—and is therefore of more than passing interest to street railway men. This station is designed for a capacity of 6,000 horse power. It is 300 feet long, 90 feet wide and will be 70 feet high. It is directly west of the municipal lighting station on Throop street, near Van Buren street, and can be doubled in size by an extension to the street, as the site and plant of the arc light station have been purchased by the company, although the city has arranged to operate its dynamos in the old building until the new station on Blue Island avenue is completed.




POWER HOUSE FOR THE METROPOLITAN ELEVATED ELECTRIC RAILWAY, CHICAGO.

The machinery foundations are of brick and concrete and have been very carefully constructed. At the start twelve 300 horse power water-tube boilers of the Babcock & Wilcox manufacture will be installed in six batteries, making an aggregate capacity of 3,600 horse power. There will be two 2,000 horse power engines and two others of 1,000 horse power each. All will be of the Reynolds-Corliss type, vertical, cross-compound and condensing. Directly connected to these engines will be two 1,500 kilowatt 550 volt General Electric generators, operated at 75 revolutions, and two 800 kilowatt machines to be operated at 100 revolutions. These machines will resemble those that attracted so much attention in the Intramural station at the World's Fair. The boilers and the smaller generators are already delivered (the dynamos unassembled on account of the size and weight of the parts), and two engines are ready for shipment in Milwaukee. It is expected that the first train will be run during December, but the date of the opening of the road for traffic cannot be predicted. The rolling stock will greatly resemble that in use on the Intramural, except that closed cars will be used. W. E. Baker, who was general manager of the Intramural road last year, is superintending the installation.

## American Street Railway Association.

This week (October 17th to 19th) the thirteenth annual meeting of the American Street Railway association is being held at Atlanta, Ga. An interesting programme has been arranged, including reports on the following subjects by special committees: "A Standard Form for Street Railway Accounts;" "Can the T Rail be Satisfactorily Used in Paved Streets?" "City and Suburban Electric Railways;" "Mail, Express and Freight Service on Street Railway Cars;" "Standards for Electric Street Railways;" "Street Car Wheels and Axles;" "The Best Method of Treating Accidents and Complaints;" "The T Rail Construction of the Terre Haute Street Railway company," and "Transfers and Commutation."

Special papers will be read on the following subjects: "A Practical System of Long-distance Electric Railway Work;" "Brake Shoes;" and "Destructive Arcing of 500 Volt Fuses."

The executive committee has secured Machinery Hall, at Piedmont Park, Atlanta, for the exhibition of supplies of every nature used in the street railway business, for two entire weeks, beginning October 10th and ending October 24th. The room for the meeting is also in the same building on the main floor, and delegates will therefore be enabled to examine the exhibits to the best advantage, and with the least possible loss of time. The exposition will be in charge of the secretary, W. J. Richardson, assisted by N. W. L. Brown, of the Atlanta Consolidated Street Railway company.

The Atlanta Consolidated Street Railway company proposes to entertain all who attend the meeting with an excursion. A typical "Georgia barbecue" will be a prominent feature of the occasion.

## Important Electric Railway Project.

A number of Chicago capitalists are said to be interested in the project of establishing an electric railway line connecting a number of towns between Chicago and Milwaukee and making a continuous system of electric service between these cities. The project has assumed definite form in the establishment of the Lake Shore Electric Railroad company, which was incorporated last week at Springfield, Ill., with a capital stock of $10,000,000. D. H. Louderback, J. L. Cochran and Dunlap Smith are mentioned as incorporators, but it is generally understood that the stock is held largely by the capitalists who are behind the Northwestern Elevated road. Indeed, Mr. Louderback, president of the Northwestern "L," is quoted as authority for this statement. The new electric lines are to be used as feeders for the Northwestern "L," much as the North Shore electric line is now used by the North Division cable system. The new line will connect with the Northwestern "L" at Wilson avenue, six and one-half miles from the county building in a northwesterly direction. A corps of engineers is already in the field making preliminary surveys for the road, which is expected to run as close to the lake shore as possible, taking in these towns along the line: Wilmette, Winnetka, Glen

coe, Lake Forest, Fort Sheridan, Highland Park, Rockland, Waukegan, Benton, Spring Bluff, Kenosha, Racine, South-Milwaukee, Cudahy, Bay View and Milwaukee. The engineering corps is now surveying the line to Waukegan. It is said most of the right of way is controlled by real estate syndicates favorable to the road and that little difficulty wil be experienced in getting the necessary property rights.

The plans of the company were outlined by Mr. Lauderback in an interview, in which he said: "We expect to connect all the towns mentioned with a trolley electric system. The plans were formed about two weeks ago, when a number of gentlemen, several of them representing large real estate syndicates, called on me and agreed to furnish the right of way if we would build the road. It all rests with them now whether the lines are constructed. If they make their promises good we will, go ahead with the work. I think this would be the largest single electric system ever put in —about eighty-eight miles. There may be several longer lines in eastern states—New Jersey, perhaps, and probably in the New England states—but they are made up of a number of short lines originally independent of each other, but now consolidated. Such lines have been very successfully operated in the East. We have come to no decision yet regarding the service to be furnished except that it will be as good as the patronage justifies.

"We may run express trains in time," Mr. Louderback resumed, "and if so they will probably make about as good time as surface steam railways. The great object in the beginning, however, would probably be to build up a popular route for summer travel. Of course our trains would run winter and summer, but by keeping as close to the lake shore as possible we could get a very popular summer route."

Mr. Louderback intimated that an arrangement might be made whereby trolley cars would be hitched directly to the Northwestern "L" at Wilson avenue when the road is completed, and hauled into the city without subjecting passengers to the annoyance of changing cars.

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It is said that an electric railroad 300 miles long is to be built, connecting Boise City and Lewiston, Idaho.

## The Electrical Expansion of the Chicago City Railway Company.

By Clement C. Smith.

On July 16th last the Chicago city council passed an ordinance permitting the Chicago City Railway company to equip its horse car lines with electricity, and on September 23d the first of the new lines, on Thirty-ninth and Halsted streets, from State to Sixty-ninth streets, was regularly operated by electric power. On July 16th the total mileage or the company was 148, of which 34.2 was cable, 15.2 electric and 98.6 horse. The council also authorized new lines aggregating 9.2 miles, so that the whole system when completed will have 123 miles of electric road and 35 of cable. These lines embrace the street car system of the entire southern part of Chicago, south of Van Buren street, and, by means of the State street and Wabash avenue cable lines and the Clark street horse car line, carry passengers through the heart of the city as far north as Lake street. On October 9, 1893, "Chicago Day" at the World's Fair, the Chicago City Railway company carried over one million passengers, of whom 208,000 were transported on the three electric lines then in operation. It possesses, therefore, one of the great street railroads of the world, and the adoption of electric power on its lines marks a notable victory for the trolley system.

Power for this great electric system is to be supplied from the new electric power station, which is located on Wabash avenue, between Fifty-second and Fifty-third streets, directly east of the State street cable station, from which it is separated by an alley. This station, illustrated diagrammatically in Figs. 1 and 2, is built of brick, one story high, and is 130 feet deep by 147 feet long. The front on Wabash avenue is of neat design, built of red pressed brick, with stone trimmings. The building stands back from the sidewalk, with grass plats in front, being intended to harmonize with the other buildings on Wabash avenue, which at this point is a street of handsome residences.

The power room is located on the Wabash avenue side, and is 94 feet deep by 130 feet long. When the installation is complete it will contain five pairs of engines and ten generators, with a total capacity of 7,000 horse power. The engines are Greene-Wheelock, with Hill valve-gear, built by Hoadly Brothers of Chicago. They are run high pressure at a speed of 100 revolutions per minute, the cylinders being 24 by 48 inches. The Hoadly compound wind system of rope transmission, Fig. 2, is used. The rope is Minerva cotton, 1¼ inches in diameter, and about 18,000 feet will be required to complete the equipment. The fly-wheels are 18 feet in diameter, weighing 50,000 pounds, and the driven pulleys are six feet in diameter and weigh 20,000 pounds each. The combination winder is six feet in diameter, and weighs 3,000 pounds. The combined weight of these wheels at the different speeds at which they are run will give a balancing power equal to 2,600 horse power for each pair of engines. All frames, crank shafts and other moving parts are made extra heavy and have stood under severe duty with excellent results.

The generators are Westinghouse four-pole machines, ten in number, each of 700 horse power, and are run at a speed of 300 revolutions per minute. The foundations are built of a solid mass of concrete, composed of Portland cement sand and crushed rock, thoroughly mixed and rammed tightly in forms built of planks, which were removed after the concrete had set. They are tied at bottom and at top by imbedding a number of old girder rails in the concrete.

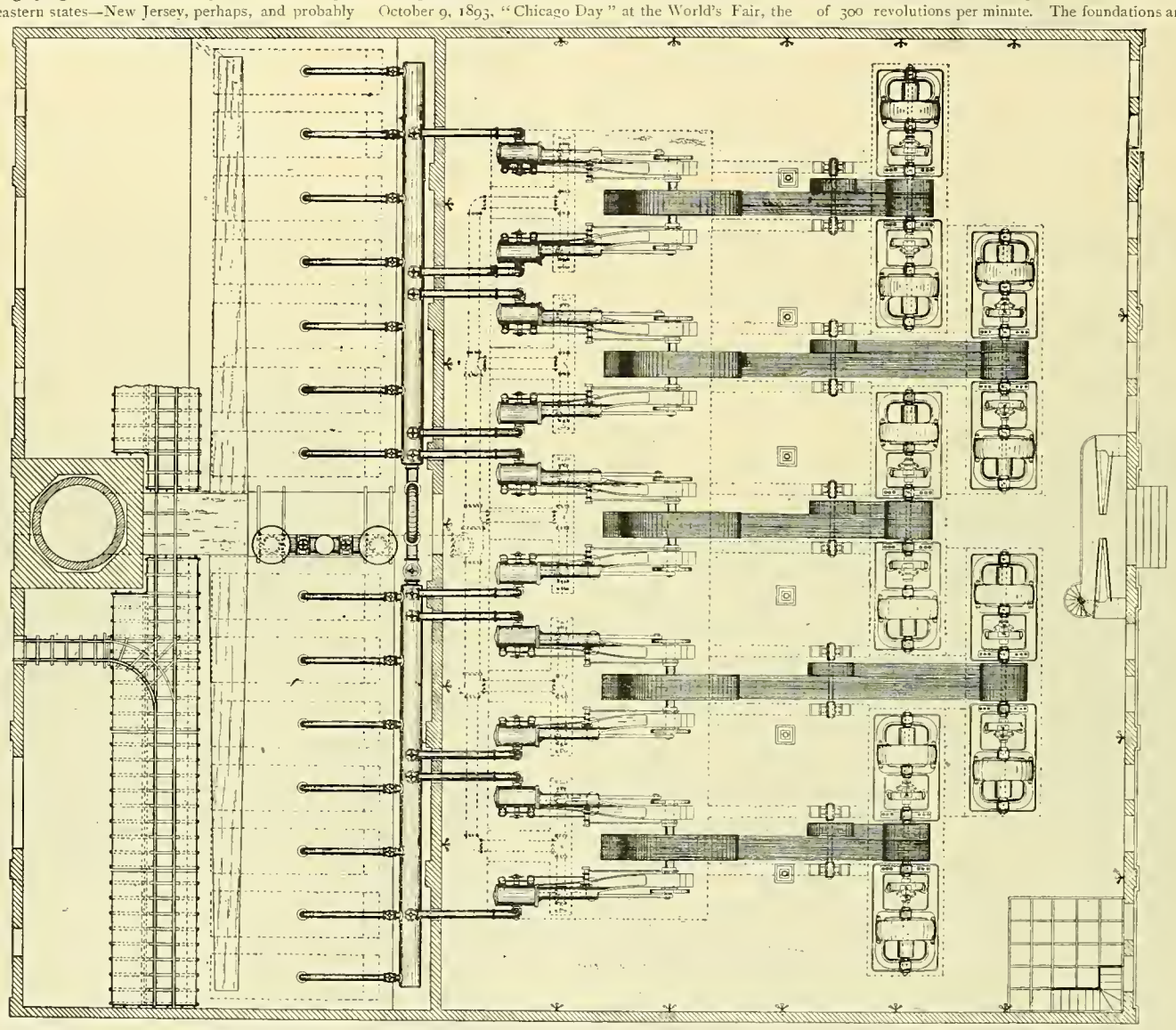

FIG. 1. ELECTRICAL EXPANSION OF THE CHICAGO CITY RAILWAY COMPANY.—PLAN OF POWER HOUSE.

The switchboard, Fig. 3, will be carried on a balcony extending along the front wall, at a height of 10 feet, floor to floor. It will be built of polished black slate, in 21 panels, and will be 68 feet long and 10 feet high. The instruments will be Weston's—all handsomely nickel-plated. Each circuit will be provided with an independent ammeter and with a three-pole switch. There will also be a main switch of 10,000 amperes' capacity, by which the entire current load can be broken. This great switch is building at the factory of the Westinghouse company, and will be operated by a motor. The bus bars will be two inches square, two for each pole. For the present there will be forty outgoing feeders, which may be increased to fifty. These feeders will run vertically from the switchboard to a water-tight cupola, and will be carried thence over the roof, on a system of strongly built racks, to the distributing pole line in the alley.

The boiler room is 54 by 130 feet, 31 feet high, and will contain fourteen tubular boilers, each 72 inches by 20 feet. These boilers will be equipped with Murphy smokeless furnaces, Baragwanath feed water heaters and Shafer exhaust injectors. The fuel is slack coal, which is stored in an elevated bin of 135 tons capacity.

Beside furnishing power for the entire electric system, this station will also furnish power to operate a 600 horse power Westinghouse six-pole motor, which will be located in the adjoining State street cable power station, 150 feet from the switchboard. This motor will replace a pair of 24 by 48 inch engines, and will drive six miles of the State street cable. This will not only be one of the largest electric motors in existence, but will undoubtedly be the first example of the utilization of electric power in driving cable machinery. If the innovation proves successful, it is likely that motors will replace the engines in the Cottage Grove avenue cable station, over three miles distant from the Wabash avenue power house. This latter change will involve the expenditure of about $55,000 for copper alone, but is expected to result in much greater economy of operation.

The cars are all built in the shops of the company, and are 30 feet long over all. They are mounted on McGuire Columbian trucks, with a wheel base of nine feet. This long wheel base is the result of a study of the subject by Superintendent Bowen, and although when introduced it was contrary to all established ideas, it has upset theories, and proved a decided success. The company has now 71 motor cars, 55 of which are equipped with two motors each and 16 with one motor each—all of the Westinghouse type No. 12, with Westinghouse controllers. The single motor cars are now being equipped with two motors. The new equipment will consist of 120 cars, with two Westinghouse No. 12 motors to each car, using General Electric "K" controllers, and two cars equipped with Walker motors. All cars will have the Gibbs trolley, made by the Gibbs Electric company of Milwaukee.

All new track is being laid with a Johnson rail weighing 85 pounds per yard. This rail, shown in section in Fig. 4, is seven inches high, with a four inch base and has the Fitch beveled head. It will be spiked directly to the ties, and the joints will be six-bolt splice bars. Where 63 pound girder rail is now in use, the track is being re-surfaced and additional ties put in at joints, laid on six inches of crushed rock well tamped.

Chicago rail-bonds are used entirely, usually two bonds to each joint of No. 00 or No. 0000 copper, with heavy copper cross-bonds at every third rail. The cable track on State street will also be bonded for some distance and will assist in making the return circuit to the station. The chief dependence for return is placed in the carrying capacity of the rails, assisted in some cases by ground wires. The bond wires are so constructed that the area of surface contact with the rail is six and one-half times the area of cross-section of bond between terminals. This proportion secures a contact which will carry the full capacity of the bond. Especial care is taken in placing these bonds, and it is believed that electrolysis of water and other pipes will be entirely avoided. A reduced map, showing the plan of bonding, is given in Fig. 5.

The special work will be of the Milwaukee type, built of girder rails with old tram guards, and the curves will be spirals. The overhead construction will be built with iron side poles, which will be of the tubular pattern, seven, six and five inches in diameter and 30 feet high. The trolley wire will be No. 0 copper, and trolley hangers with hard rubber insulation and Chicago City railway clips, will be used. The feeders will be of various sizes, from No. 00 to 500,000 circular mils, and will be carried usually on ornamental arms placed on the side pole line. The principal feeder line, however, will be carried on poles located in the alley between State street and Wabash avenue.

The whole work is now well under way, and it is intended that the equipment of the station shall be completed by January 1, 1895, and that the greater part of the present horse car lines shall be then operated by electricity. M. K. Bowen, superintendent, has full charge of the entire construction as well as of the operation of the road. Robert Hill is chief engineer of the mechanical department, which includes the cable as well as electric stations. E. H. Hovey, is master mechanic; E. P. Hall, trackmaster; R. L. Garth, purchasing agent, and G. W. Knox, electrical engineer.

## Electricity on Elevated Railroads.

By B. J. Arnold.

Those who attended the Exposition of Railway Appliances held in Chicago in 1884 will remember the small electric road which surrounded the gallery of the Exposition building and carried passengers on flat cars drawn by an electric locomotive called "The Judge."

While this enlarged toy attracted much attention and demonstrated that trains of moderate weight could be propelled by electricity, few realized that it was the forerunner of the modern elevated road, and that a brief period of ten years would bring the Liverpool Overhead Railroad in England and the Intramural in this country to prove conclusively the feasibility of electricity for heavy traction work, and that the observers of this period would witness the remarkable revolution in interurban railroads that has taken place. Unfortunately for electric traction, the Daft experiments made on the New York Elevated road in 1888-89 were carried out under such unfavorable circumstances that the results were such as to give a serious setback to the "new power" and scattered skepticism among railroad men generally. The manufacturing companies were kept so busy filling the orders for surface road equipments that but little attention was paid to the development of the heavier and more important equipments for elevated railroad service. Furthermore, we were told that electricity would do very well to run sewing machines, small motors for light manufacturing and other easy work, but to think of building motors for heavy duty, capable of hauling railroad trains, was absurd.

The insulation could not be made to stand the high voltage necessary for the adoption of an electromotive force high enough to secure economy in installation; large, slow running motors would be inefficient electrically, and if gearing were used it could not be made to do the work, "for," said the steam engine advocate, "a steam locomotive has no gears," and, "they were originally built with them and had to be abandoned."

Again, the cost of electrical machinery was so high, caused by one or two corporations controlling all the important patents and the enormous experimental and selling expense unavoidable in the early stages of such an industry, that its cost for large installations was prohibitive. It was argued that if trains were all dependent upon one source of power the entire road would be disabled in case of accident to any particular train.

The rapid adoption of electric motors to surface traction eliminated largely the objections mentioned, but it was no until the Liverpool Overhead road in England and the Intramural in this country were successfully built and operated that the doubters began to be convinced.

With the Metropolitan of Chicago now equipping twenty miles of elevated road for electric traction at a cost of $400,000 more than steam equipment would have necessitated; with the Northwestern arranging to equip electrically, and the Lake Street and Alley "L" companies wishing they had done so, it would seem that the question has been pretty effectually settled in favor of electricity by those most competent to judge.

The elevated road of the future will probably be built on the following general lines: The structure will be of steel about two-thirds of the weight of the present structures built for steam service. The current will be carried to the trains by means of a trolley line consisting of a cheap grade of railroad rails, which it has been found can be purchased and laid for but little over half the cost of copper conductors of a given conductivity, or by a specially rolled square steel bar. The active or "live" trolley will be supplemented by one or more similar rails, or bars, as the distance from the power house and number of trains increase. Sliding contact trolleys have thus far proven preferable and will probably be adhered to for future work at higher speeds.

So far as present indications point, we shall maintain the direct current motors attached directly to the axles of the forward or motor car. The idea of having a separate electric locomotive for elevated work seems inadvisable for the following reasons:

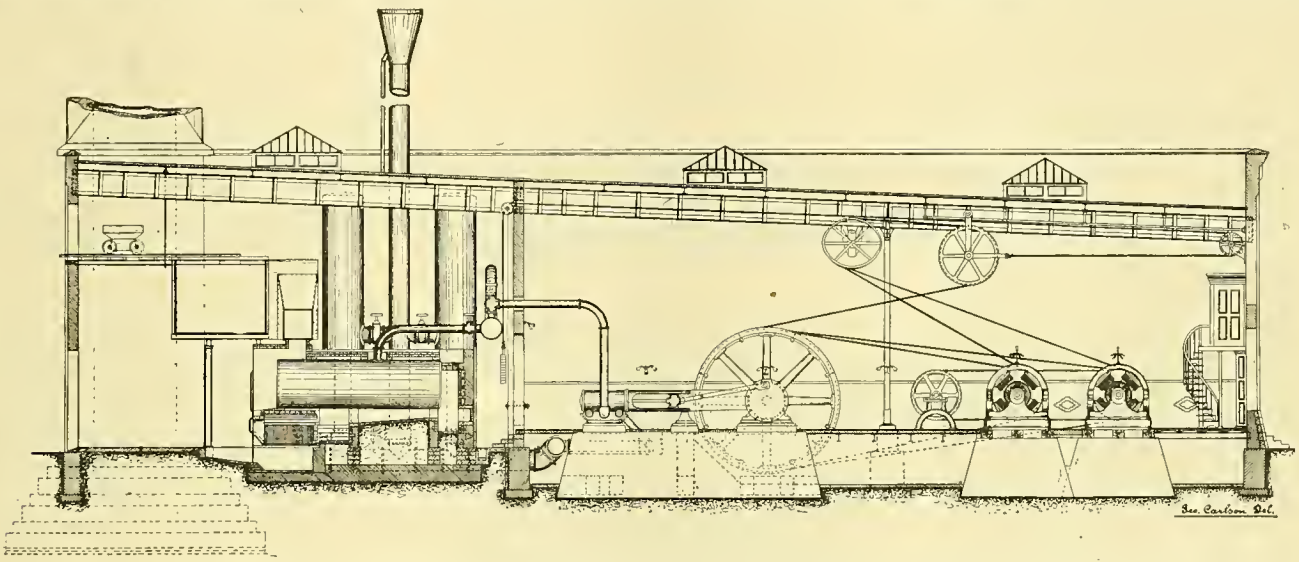

FIG. 2. ELECTRICAL EXPANSION OF THE CHICAGO CITY RAILWAY COMPANY.—SECTION THROUGH POWER HOUSE.

With a motor car the wheel base is longer, allowing a lighter structure; the entire weight of the passengers on the motor car is available for traction and it saves practically the cost of the electric locomotive itself.

Furthermore, comparisons between the Liverpool Overhead railroad and the City & South London Underground lines show that the tractive force per ton of locomotive is as 730 to 367, or a ratio of nearly two to one in favor of the motors mounted directly on the motor car. This, combined with the saving in cost, ought to be sufficient proof in favor of the motor car.

Few railroad men will not now willingly admit the feasibility of an electric brake, but this feature must eventually be worked out in detail, and so designed that it will take the place of air brakes on elevated trains.

It must be operated by the counter current generated by the motor armatures and be entirely independent of current from the trolley or any external source. That this idea will meet with opposition is to be expected, but that it will eventually be generally adopted and made practical is in the writer's judgment certain. In fact, it has already been carried to a degree of perfection which warrants investigation by engineers and others who have to do with the equipment of electric roads. The practical objection to the automatic air brake on elevated service is its inability to release quickly enough to enable trains to get away from the station as rapidly as they should, the jerky motion imparted to the trains when stopping and the great liability of skidding or sliding the wheels. The electric brake removes these objections entirely and promises to largely reduce the cost of maintenance for wheels and brake shoes.

In the power station the tendency will be toward larger and fewer units of power, resulting in decreased cost for labor and repairs. Direct-coupled engines and generators will be used exclusively, and belted machinery will be con-

idered out of date. Boilers will be set with furnaces for burning slack coal, or, better still, refuse or garbage, thus reducing the cost of fuel to practically nothing, and in many cases the railroad company may receive pay for consuming the debris.

The power station should be located as near the center of the line as possible and be able to secure water for condensation. The boilers should be capable of evaporating 10 pounds of water per pound of good bituminous coal, or 7½ pounds of water per pound of good quality of bituminous screenings or slack. The feed water should be heated by means of economizers to a temperature of 300 degrees before entering the boilers. Cast-iron pipes for main steam and exhaust headers, with copper bends for turning corners, will be found to be the least expensive to maintain and keep in proper working order. The engines should be designed extra heavy throughout, and provided with a valve motion which will permit steam being carried to at least three-quarter stroke on both high and low-pressure cylinders, to be able to meet the temporary overloads. In case battery auxiliaries are used this feature need not be imperative. The engines should be capable of producing a horse power hour on 20 pounds of water when working on a variable load, and 15 pounds per horse power hour when running on a constant load at their rated power.

The friction load of engine and generators should not exceed 13 per cent., and the efficiency of generators should be not less than 96 per cent. on full load.

The loss in conductors between generators and switchboard should not exceed one per cent., and the conductors so placed that they can be thoroughly insulated and easily inspected.

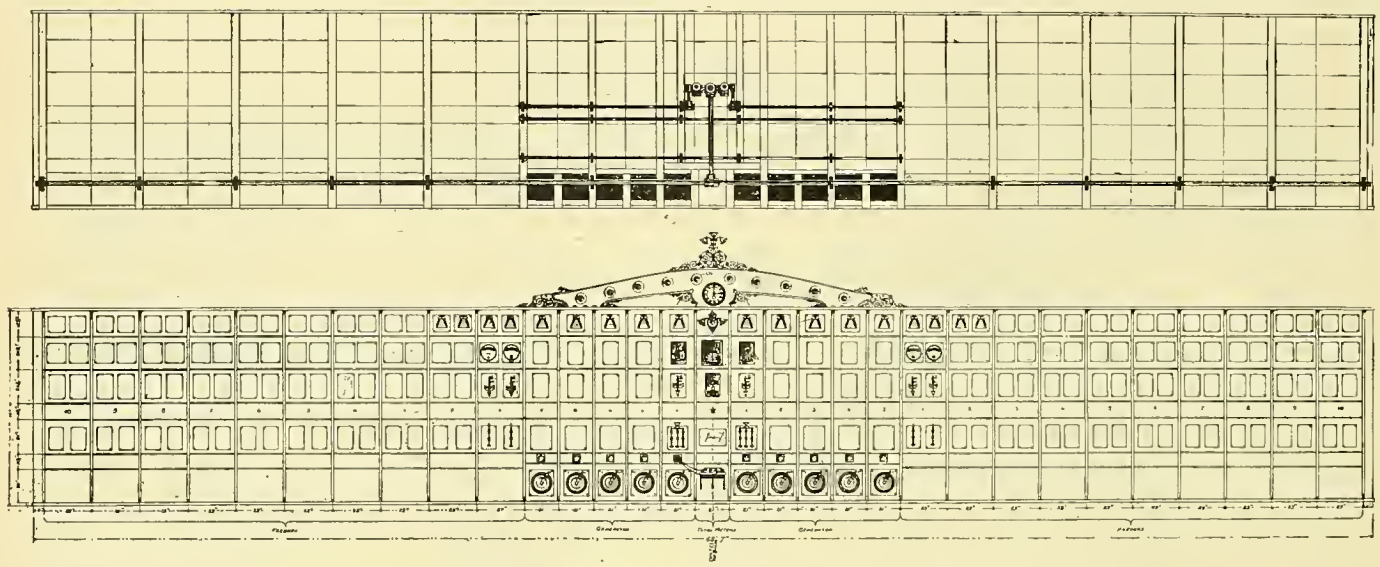

FIG. 3. ELECTRICAL EXPANSION OF THE CHICAGO CITY RAILWAY COMPANY.—A LARGE SWITCHBOARD.

A station so designed and properly operated should be able to deliver a kilowatt hour on the switchboard for one cent, exclusive of motormen's wages, and interest on the investment, but including all labor, fuel and miscellaneous expenses incident to the production of power. From this basis and from data secured from the records of the Intramural during its operation, relative to the amount of power consumed per train mile, I have compiled the following table showing the cost for power on elevated electric roads at various speeds, with a given weight of train, assuming labor at average rates, and that bituminous slack coal can be delivered at the power station for $1.25 per ton:

| Number of cars and weight of train. | Average running speed in miles per hour. | Cost of power per train mile in cents, including power station labor, but excluding train service. |
|---|---|---|
| 2-car, train at 40 tons loaded... | 12 | 2.66 |
| | 15 | 4.16 |
| | 18 | 5.98 |
| 3-car train at 60 tons loaded.... | 12 | 3.99 |
| | 15 | 6.23 |
| | 18 | 8.97 |
| 4-car train at 80 tons loaded .. | 12 | 5.40 |
| | 15 | 8.39 |
| | 18 | 12.80 |
| 5-car train at 100 tons loaded.... | 12 | 6.65 |
| | 15 | 10.39 |
| | 18 | 14.95 |
| 6-car train at 100 tons loaded.... | 12 | 7.98 |
| | 15 | 12.46 |
| | 18 | 17.95 |

These figures should be obtained under present practice, and it is my opinion that the results of the road now being equipped in Chicago will conform very nearly to them. It should be remembered that they are much higher than they will be in through-train service owing to there being so many and frequent stops. Almost the entire amount of power is consumed in accelerating the trains.

In these estimates I have assumed that an average load of 3,000 horse power would be required, and that no battery auxiliary or other means of equalizing the load is used, although I believe that such an equalizer will eventually be adopted in railroad stations, resulting in the cost of power being materially reduced.

## Storage Battery Litigation.

As announced in the last issue of the WESTERN ELECTRICIAN, an injunction was granted on Monday, October 8th, in the Circuit Court of the United States for the Southern District of New York, in the case of the Accumulator company against the Edison Electric Illuminating company, New York, impleaded with the Electric Storage Battery company. The opinion was prepared by Judge Lacombe, and is presented herewith:

The battery company, which is named as a defendant, but which, being a non-resident, has not been served, and does not appear, manufactures the articles alleged to infringe. The illuminating company has contracted to purchase a large number of them, and is about to put them to use in this city. Complainant is the owner of Letters Patent, Reissue No. 11,047, December 17, 1889, original No. 312,599, February 17, 1885, to J. W. Swan, for "secondary battery," a variety of electric storage battery. The original patent, No. 312,599, was considered by this court in Accumulator vs. Julien company, 38 Fed. Rep., 117, and held invalid, as it described and claimed more than the inventor discovered. Thereupon the reissue was obtained, and said reissue was considered by this court and sustained in Accumulator vs. N. Y. & Harlem R. R. Co., 50 Fed. Rep., 81 (opinion by Judge Coxe). In an application, therefore, for preliminary injunction on the same patent the construction laid down in that opinion will be adhered to. The claim of the patent is for: "A perforated or cellular plate for secondary batteries, having the perforations or cells extending through the plate and the active material or material to become active packed in the said perforations or cells only, substantially as described."

Judge Coxe held that although the art already showed plates in which the active material was packed into grooves or holes not extending through the plate, and also plates where the active material filled not only the perforations, but also the entire surface of the plate itself, Swan's combination, in which the perforations extended through the plate and the material filled the perforations only, was original with him; that it was not only new but useful, an important advance in the art, and that "the idea which has made these plates a commercial success was first given to the world in a practical embodiment by Mr. Swan." No new evidence tending to modify Judge Coxe's opinion being introduced, it settles the law of this case, and the only question here is whether defendant's plates infringe.

These plates, which are for secondary batteries, are perforated plates, the perforations extend through the plate, the active material is found in the said perforations, and in them only. Infringement by the completed structure is so plain that defendant has been constrained to insist that Swan's patent is practically for a process and, therefore, as defendant's process of making the plates is a different one, there is no infringement. Thus Swan constructed a plate with perforations or cells extending through it, and then packed the material in the perforations; defendants arrange pastilles or buttons of the material in a mold and then cast the plate around them. Manifestly the result is the same, whether the material is packed within the bounding walls of the perforations, or whether the bounding walls of the perforations are packed around the material. Defendants also insist that the material which they use is not active when the process of packing antimonious lead around it is complete, and that it does not become active the moment it is placed in the battery fluid, but requires further electrolytic treatment before it becomes active. But the patent are not confined to active material, it includes "material to become active," and whether it becomes active by one process or another is apparently immaterial. The gist of Swan's invention as found by Judge Coxe, was the confining of the material which was to do the work within perforations which extended completely through the plate. The advantages of such plates are pointed out in his opinion, and those which defendant threatens to use are plainly such plates. There is nothing in the patent or in Judge Coxe's opinion which supports the contention that the claim is other than what it appears to be—a claim for a completed article, not for a process of manufacture. Infringement is clear.

It is further contended on behalf of the defendant that complainant has been guilty of such laches as should preclude the granting of a preliminary injunction. In a case where this defendant, or its allied corporation, was complainant the Court of Appeals in this circuit held that the owner of a patent was under no obligation to sue every infringer forthwith upon discovery of the infringement, provided he proceeded with due diligence against the one whom he did sue (Edison Electric Light Co. et al vs. Sawyer-Man Electric Co., 3 C. C. A., 605). There is no suggestion of any unreasonable delay in prosecuting the test suits against the Julien Company and the N. Y. & Harlem R. R. Co. Judge Coxe's decree in the last named suit is dated April 12, 1892. The present action was begun in August, 1894. During the intermediate period and for some years before, certainly since 1889, the Storage Battery company made plates which differed from those sold to the Illuminating company, both in the size of the plate and in the size of the buttons. The plate now complained of is 15 inches square, and contains 256 buttons of active material; the older plates were 6 by 8 inches and contained 9 or 12 buttons. Both were equally infringements of the patent, which is not confined to plates or buttons of any particular, absolute or relative size. Complainant insists that it did not prosecute for infringement by the earlier plates, for the reason that it did not believe them to be commercially harmful. The grounds for that belief are said to be the relative size of plate and button. In the latter plates the loss by accident, while in use, of the contents of a single hole, would not, it is asserted, practically destroy the usefulness of the plate, being only a loss of 1-256 of the active material. A similar accident to the older plate, however, would destroy its usefulness, as a single perforation holds 1-9 or 1-12 of the active material. This explanation seems a reasonable excuse for failing to prosecute against the older plates, and I find nothing in the transactions between the complainant's officers and those of the Storage Battery company, which should estop complainant from maintaining this action. In April, 1893, certainly both sides understood and expressed their understanding in writing that the question of infringement of the several patents owned by complainant would be tested by suit.

As to the Danish patent, the conclusion reached by Judge Coxe without argument, viz., that "it is not for the same invention as the Swan reissue," is concurred in by this court, after argument.

Motion for preliminary injunction granted.

Judge Lacombe, of the United States Circuit Court, on October 10th denied the motion of the Edison Electric Illuminating company to suspend, pending appeal, the injunction granted by him on the previous Monday (October 8th,) against the use of the chloride battery.

## Rapid Transit for Cicero.

Residents in the northern portion of Austin, Moreland and Oak Park are rejoicing over the near prospect of electric railway facilities which will bring them from fifteen minutes to an hour nearer the heart of Chicago. The Cicero & Proviso Railway company began the construction of its northern extension last week, and work will be pushed rapidly with the intention of having the cars running before spring. The new branch starts at the intersection of West Forty-eighth and Lake streets, runs northward along Forty-eighth street to West Chicago avenue, thence westward to Harlem avenue, thence south in Harlem avenue to Lake street, where it connects with the line already in running

order and forms a great loop. As the road is now the property of Mr. Yerkes, the branch will be used to feed the Lake Street "L" road. Those who are familiar with railroad affairs say that this move on the part of Mr. Yerkes was mainly for the purpose of forestalling the Northwestern Elevated road, which, when it was built, would naturally draw more or less from the portion of country served by the new electric line.

## North and West Side Surface Electric Railway Systems, Chicago.

While work on the North and West Side electric railway extensions in Chicago is not in such a forward state as on the South Side, many of the contracts have been let and operations have been begun on both the power houses—that on the North Side at California avenue and Roscoe boulevard, to be ultimately of 6,000 horse power, and that for the West Side, at Washington boulevard and Western avenue, to be of 7,000 horse power. The Siemens & Halske company will supply the generators for both the stations, and Fraser & Chalmers will supply the engines for the West Side system. James R. Chapman is the superintendent of electric construction for both of these extensive railway systems. An idea of the amount of work that will come under his charge may be had from the following lists, filed with the Department of Public Works, of streets on which it is intended to equip electric lines:

*North Side.*

Division street, from Clybourn avenue to Milwaukee avenue, one block of which is equipped from Elston avenue east; Chicago avenue, from Clark street to Milwaukee avenue; Sedgwick street, from Center street to Division street, west on Division street to South Sedgwick street, thence south to Chicago avenue; Market street, from Division street to Chicago avenue; Market street, from Chicago avenue to Kinzie street, thence east on Kinzie street to State street; Wells street, from the river to Illinois street, thence on Illinois street to Market street; Michigan street, from Wells street to Market street; State street, from the river to Division street, thence west on Division street to Wells street; Fullerton avenue, from Lincoln avenue to Racine avenue, thence south on Racine avenue to Garfield avenue; Webster avenue, from Racine avenue to Lincoln avenue; Halsted street, between the south side of the bridge across the North Branch and North avenue; Clark street, from Lawrence avenue to Homan avenue.

*West Side.*

North avenue, from Milwaukee avenue to Crawford avenue; Division street, from Milwaukee avenue to California avenue; Chicago avenue, from Milwaukee avenue to Grand

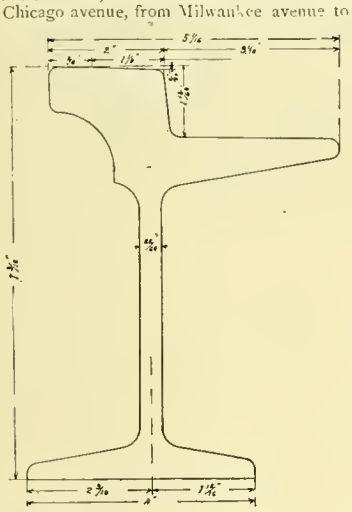

FIG. 4. ELECTRICAL EXPANSION OF THE CHICAGO CITY RAILWAY COMPANY.—RAIL SECTION.

avenue; California avenue, from Chicago avenue to Division street; Armitage avenue, from Milwaukee avenue to Columbia avenue; California avenue, from Armitage avenue to North avenue; Ashland avenue, from Clybourn place to Lake street; Paulina street, from Lake street to Twelfth street; Ashland avenue, from Twelfth street to Blue Island avenue; Indiana street, from Western avenue to Halsted street; Halsted street, from the river to Van Buren street; Lake street, from Forty-eighth street to the east side of the river; Randolph street, from Ogden avenue to the east side of the river; Bryan place, from Lake street to Randolph street; Western avenue, from Blue Island avenue to the west side of river; Harrison street, from Western avenue to the east side of river; Clybourn place, from Wood street to Ashland avenue; North avenue, from Ashland avenue to Holt street; Holt street, from North avenue to Blackhawk street; Blackhawk street, from Holt street to Noble street; Noble street, from Blackhawk street to Milwaukee avenue; Erie street, from Ashland avenue to Center avenue; Center avenue, from Erie street to Austin avenue; Austin avenue, from Center avenue to Desplaines street; Sangamon street, from Austin avenue to Adams street; Crawford avenue, from North to Grand; Columbia place, from Madison street to lake; Grand avenue, from Western to Crawford; Leavitt street, from Indiana to Chicago avenue; Fourteenth street, from Robey to Canal; Ogden avenue, from Madison street to Randolph; Desplaines street, from Harrison to Austin avenue; Robey street, from Blue Island to Milwaukee avenue; Colorado avenue, from Crawford to Madison street; Kedzie street, from Twelfth street to Madison street; Twenty-first street, from Western avenue to Center avenue; Ogden avenue, from Crawford avenue to Madison street; Twelfth street, from Crawford avenue to the east side of river; Taylor street, from Western avenue to the east side of river; Center avenue, from Twenty-first street to Adams street; Adams street, from Center avenue to the east side of river; Eighteenth street, from Leavitt street to the east side

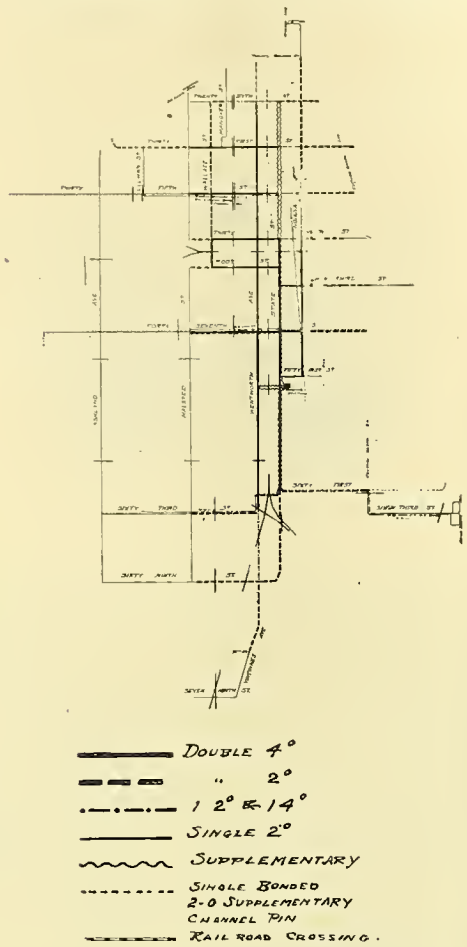


FIG. 5. ELECTRICAL EXPANSION OF THE CHICAGO CITY RAILWAY COMPANY.—MAP SHOWING SYSTEM OF RAIL BONDING

of river; Leavitt street, from Blue Island avenue to Eighteenth street; Canalport avenue, from Halsted street to Canal street; Canal street, from Canalport avenue to Harrison avenue; Clinton street, from Twelfth street to Milwaukee avenue; Jefferson street, from Meagher street to Van Buren street; Meagher street, from Jefferson street to Canal street.

## The New and the Old in Rail Bonding.

The accompanying illustrations speak eloquently of the advance in the art of bonding the rails of electric railways within the last two or three years. In Fig. 1 is shown the heavy copper rail-bond now being placed for the electrical track equipment of the Chicago City Railway company, while beneath it, small and insignificant by contrast, is an iron rail-bond recently taken up from the tracks of one of the most important electric railway systems in the West. This bit of iron wire was put in position less than two years ago, when it was, presumably, supposed to be sufficient for all requirements. It is considerably corroded, and

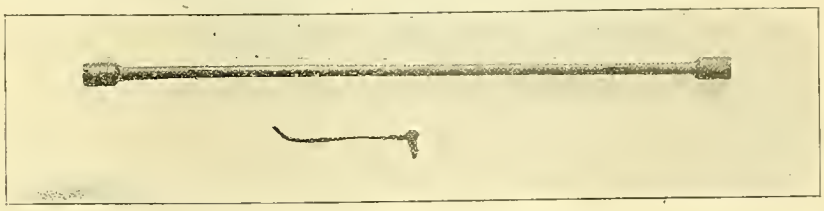

FIG. 1. THE NEW AND THE OLD IN RAIL BONDING.

other iron bonds on the same line were in even worse condition, the one illustrated having been picked up at random. It is proper to add, however, that on the same system there are bonds of similar shape but of No. 4 copper wire which have been in use for over four years and are apparently in as good condition to-day as when first put down. The company having this experience has now adopted copper bonding throughout. The heavy copper bond shown in Fig. 1 consists of a rod of copper two feet long and five-eighths of an inch in diameter, with ends adapted to give a wide area of contact with the iron rail when bent and swedged in position by an iron pin. The contrast between the heavy piece of copper and the light iron wire shows in a very striking manner the advance made in rail bonding, in the endeavor of electric railway companies to provide a practically complete metallic circuit from the motor to the generator and thus avoid the evils of escaping current and electrolysis.

Similarly, in Fig. 2, is shown a modern copper cross-bond in contrast with a section of a two-year-old cross-bond made of stranded iron wire. The latter was taken from the road already referred to as having recently substituted copper for iron bonding. It is badly corroded. The copper cross-bond is a solid rod of copper, slightly less in cross-section than the rail-joint bond.

## The Northwestern Electric "L" Road Project in Chicago.

Since it has been definitely known that Mr. Yerkes was in control of the Northwestern Elevated Railroad company, which was organized to build an elevated electric railroad on the North Side, Chicago, popular interest in

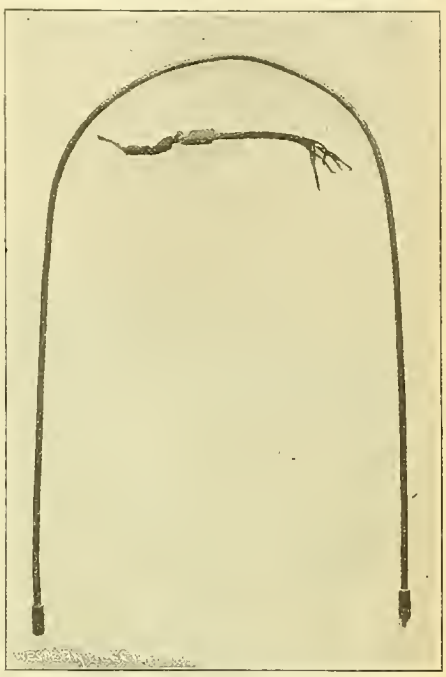

FIG. 2. THE NEW AND THE OLD IN RAIL BONDING.

the project has lagged. Still the scheme has not been abandoned. The company has filed a mortgage to the Illinois Trust and Savings Bank, trustee, for $15,000,000. These mortgage bonds are for the purpose of completing, equipping, improving and operating the road. They bear 5 per cent. interest, and the principal is due August 1, 1944. For the railroad company the bonds are signed by D. H. Louderback, president, and Howard Abel, secretary.

It is stated that the work thus far has been confined wholly to the acquisition of the right-of-way. It is said unofficially that about $750,000 has been spent so far in buying real estate. The statement is further offered, and this by authority, that nothing in the way of giving out contracts or doing anything in actual construction will be done until next spring. Past experience has impressed the fact upon those engaged in the construction of "L" roads in Chicago that a great deal of money can be saved by going slowly in buying real estate. The backers of the Northwestern say that they intend to build the road as cheaply as it can be done. They expect, however, to have a line in operation five or six miles north before the close of 1895.

An electric car mail service is being agitated in Rochester, N. Y. As the contract with the company now carrying the mails from the postoffice to the depots does not expire for three years, the movement is not a very definite one.

## De Ronde-Bennett.

In Teaneck, Englewood, N. J., Thursday evening, October 11th, Miss Kate Weaver Bennett was married to Frank S. De Ronde, at the residence of the bride, the ceremony being performed by the Rev. George Flickner of Englewood. Masters Ludwig Filbert and Lewis De Roude preceded the bridal party, strewing flowers in the pathway. The best man was Alfred R. Bunnell of New York.

The wedding was a delightful home affair, only the near relatives and friends being present. The house was elaborately decorated with flowers, ferns, palms and autumn leaves, under an arch of which the ceremony was performed. The wedding presents were numerous and costly, among them being a beautiful bronze figure, Gloria, by Bereau, presented by the Standard Paint company of New York, of which Mr. De Ronde is general sales agent. Mr. and Mrs. De Ronde left for an extended trip through the South. Upon their return they will reside at Englewood in a new home recently completed for them. The many friends of Mr. De Ronde will wish him all joy, but none more so than those of the electrical fraternity.

## The Electric Appliance Company, Chicago.

When the Packard lamps or transformers, Paranite or O. K. wires, Meston alternating current fan motors and a score of other well-known specialties are mentioned in the West, their names are closely associated with that of the Electric Appliance company, Chicago, for during the last three years that company, as the general western agent of these goods, has been introducing and pushing their sale in its territory with much energy and a good proportion of success. The Electric Appliance company is an example of what can be accomplished by the determined and continued efforts of experienced men in the electrical supply business. The company was organized about three years ago upon a comparatively small basis. Three men constituted the working force of the young concern, and more than the usual obstacles had to be encountered and overcome in the early history of the company, which was handicapped by a lack of capital and predictions of the failure of the enterprise. However, two first-class specialties were obtained during the first year of the company's existence—Paranite rubber-covered wire and the Packard incandescent lamps. With these as a nucleus for future development, other prominent and reliable articles were added to the general electrical supply stock, until the business has expanded into the dimensions suggested by the illustrations which accompany this article.

WILLARD W. LOW. THOS. I. STACEY.

The names of Willard W. Low, president, and Thos. I. Stacey, secretary and treasurer, are most intimately linked with the interests of the business, as it has been by their united efforts that the company has attained its present proportions. Mr. Low's photograph, presented in connection with that of Mr. Stacey, will be recognized by most of the electrical supply men and those engaged in kindred interests throughout the company's territory, which extends through the southern states, west to the Rocky Mountains and east to New York. Until the last year Mr. Low has traveled extensively in the interests of the company, but is now paying more attention to the sales and supply department. His experience and acquaintance in the electrical business for ten years has been of great value to the Appliance company, and, added to these qualifications, his numerous friends will emphasize the statement that his congenial personal attributes have made his name a prominent one in electrical circles and have gained him the reputation of a popular gentleman. Mr. Low was first connected with the old Detroit Electrical Works in the capacity of shipping clerk. Later he came to Chicago and entered the electrical supply business, and in 1891 embarked with Mr. Stacey in his present company. Mr. Low, is 36 years of age and has made Chicago his home for the last six years.

Thos. I. Stacey, the secretary and treasurer of the company, although but 25 years of age, has been connected with the electrical supply business in Chicago since 1887. Mr. Stacey early determined upon his career and showed a natural inclination for the business in which he is engaged. His first insight into the peculiarities of his particular branch was obtained in the capacity of stenographer. He was quickly promoted to a more important position, however, and one in which he had an opportunity to obtain experience and a knowledge of the requirements of the electrical business. Since the Appliance company has been formed, Mr. Stacey has devoted his most careful attention to the management of the business and financial departments. The growth of the store and business, and the increase in three years of the working force from three to thirty-five or forty, tells for itself of his ability and application. The company has a number of traveling men upon the road, who cover the large territory already mentioned.

Fig 4. Switchboard. Fig. 5. Basement.

Fig. 6. Shipping Department.

THE ELECTRIC APPLIANCE COMPANY, CHICAGO.

The store is located at 242 Madison street, and as seen by the exterior view, Fig. 2, includes practically the whole of a three-story brick building. The building is 150 feet deep, which allows of the ground floor being divided into the sales and shipping departments and the business offices. The salesroom, Fig. 3, is of sufficient size to display even the large stock of the company, and a good idea of its arrangement may be gained by the picture. In Fig. 4 is shown the testing instrument case and a switchboard upon which are mounted samples of the company's goods, including knife switches, Paiste switches, lamps, annunciators, cut-outs and house goods in general. Upon the shelves at each side of the store the smaller and minor articles are stored for retail business. Back of the salesroom are the offices and bookkeeping departments, Fig. 1, while in the rear, still farther is the shipping room. The store of the Electric Appliance company is most essentially a busy one, particularly at this season of the year, and the shipping department, as seen in Fig. 6, is fully indicative of this. It is admirably located to furnish the company the most complete facilities in this direction, although, large as it is, it is usually crowded to its capacity by outgoing supplies. The basement, Fig. 5, extends the full depth of the building and is utilized as the principal storing place. The extent of the stock is not fully defined by the photograph, as it was taken by the aid of artificial illumination and does not penetrate the full length of the basement. It is sufficiently comprehensive, however, to show the large quantities of goods carried in stock by the company, making it possible for it to ship orders even of more than ordinarily large size promptly. It is the policy of the company to make its show windows present an attractive and interesting appearance, and the lines of goods are changed frequently to draw trade in all of its branches.

The stock of the company is a representative one in the electrical supply business. Its specialties have been selected with care, and only those articles have been taken into consideration which have been proven to the satisfaction of the company to be first-class and reliable in every way. The company is the largest selling agent of the Indiana Rubber & Insulated Wire company, whose factory is illustrated and described elsewhere in this issue, and this line, of course, is made a feature of the business. Another agency which was secured by the company, and which is of great importance, is that of the New York & Ohio company of Warren, O., manufacturer of the Packard lamps. This lamp has been upon the market since 1888, in that time gaining an enviable reputation as a high grade lamp. The marked maintenance of candle power in the Packard lamp, for which the company claims particular merit, is due to a special process, an extra treatment to which the carbon is subjected and which is, as far as known, unused in the manufacture of other lamps. The standard efficiency of the lamp at full 16 candle power is 3.5 watts per candle power, but other efficiencies are furnished when required. The lamps range in candle power from five to 500 candle power. The Mogul Packard (those of 200, 300 and 500 candle power) are of 2½ to 3 watts per candle power efficiency. The advantages of using the Mogul lamps as compared with 16 candle power lamps include the facts claimed—that the cost of lamp per candle power is less; that the cost of wiring per candle power is less; that the saving in current will, on the average, pay for the renewal of the lamp; that when burned at the same incandescence the life is longer, and that, with the same dynamo and engine power, a third more light can be obtained. All the various sizes are carried in stock by the Appliance company at its store. The Packard transformer, manufactured by the Packard Electric company, Warren, O., has been thoroughly described in the columns of this journal, and has also made a fine reputation for itself. The company includes regulation, general efficiency, insulation, a general neat and compact appearance and a fuse block for primary fusing in its claims for superiority. The Packard transformer has been a very satisfactory speciality of the Appliance company. The demand for a high grade weatherproof wire induced the company to take the agency for O. K. weatherproof wire. The trade is beginning to have the fact impressed upon it by experience that the question of quality is a most important factor in weatherproof wire, and O. K. wire meets so satisfactorily the necessary requirements that it has achieved a good degree of success and has met with a steady demand. The Appliance company is in one case a producer. It manufactures one of its most recent specialties, the Allen soldering stick. The advantages derived from the use of this specialty are of importance and worthy of consideration. By its use joints which are now made by acids are made more readily by the stick, which is a composition of soldering salts particularly adapted to electrical work. In alternating fan motor work the Meston outfits have become very popular and during the summer months they constitute a leading feature of the company's sales. The regular fan motor of this make is of about one-eighth of a horse power capacity, weighs about 20 pounds and turns a 12 inch 6 bladed fan at any speed desired up to 2,000 revolutions. The motor is supplied with carbon brushes that will last a season and can be readily renewed at any time. It is practically self-oiling and the speed can be regulated or the motor reversed at will by a small hand lever. Among the many smaller articles handled by the company, perhaps none is of greater merit than the Standard single push flush switch. By means of this switch the light is operated by a single push; if the light is off, a single push turns it on; if the light is burning, a single push turns it out. The switch is very compact and is manufactured in sizes of 5 and 10 ampere single-pole, 5 and 10 ampere three-way and 5 and 10 ampere commutation. By using the commutation switch, a light or group of lights may be controlled from any number of

points without in any way interfering with each other thus entirely superseding the old method of operating with push keys, automatic switches and batteries or auxiliary switch circuits.

It goes without saying that the Appliance company is fully provided with all of those articles necessary to the lineman and bell-hanger, and which are in one form or other the common property of all first-class electrical supply houses. As will be shown by its large illustrated catalogue which is soon to be issued, the company carries a line of supplies which in point of completeness is perfect. It can supply workmen's materials, special lamp shades, electric joints, desk clamps for electric lamps, fixtures of all designs, fuses, cut-outs, expanding wire guards for incandescent lights, sockets, magnets, bells, batteries, burglar alarm apparatus, push buttons, annunciators of all descriptions, portable testing instruments, Whitney measuring instruments, tools for all classes of electrical work, junction boxes, arc light and station supplies, fire alarm and district telegraph supplies, telephone induction coils, gas lighting materials, etc. All of these supplies are of the finest grade of workmanship and are all made in accordance with the latest practice. Much care has been taken to obtain a special line of house goods, and many novelties are to be found in stock. In addition to its regular stock the company has just made arrangements with the Lynn Manufacturing company to handle its extensive line of electric railway appliances. This arrangement will enable the company to take front rank in the railway supply business with a full line of standard goods.

Last year was made the occasion of a special effort upon the part of the company to extend the scope of its work, and visitors to the electrical department at the World's Fair cannot fail to recall the well arranged and comprehensive display exhibited. The policy of the company during this year has been aggressive, and its success may be judged from the appearance of its store. Great credit is due its managers, and the growth of the business is a gratifying evidence of the widespread influence of the Electric Appliance company.

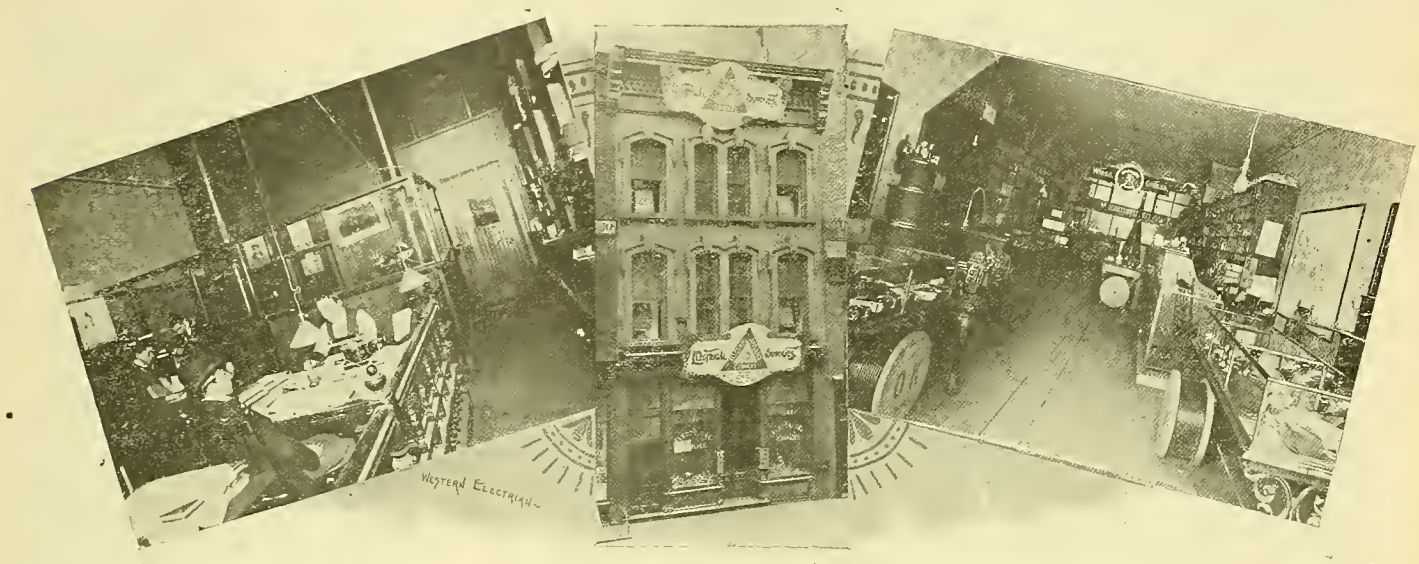

Fig. 1. Offices

Fig. 2. Exterior View.

THE ELECTRIC APPLIANCE COMPANY, CHICAGO.

Fig. 3. Salesroom.

## Electric Storage Battery Company's Statement.

The following special dispatch to the WESTERN ELECTRICIAN from the Electric Storage Battery company of Philadelphia, explains that corporation's position in the legal controversy over the accumulator, now being conducted in the United States Court:

In view of the publicity given to Judge Lacombe's recent decision in the case of the Accumulator company vs. the Edison Electric Illuminating company of New York city, directed against our chloride accumulator, and based upon the Swan re-issued letters patent, which expires May 24, 1895, we deem a statement of facts necessary that our customers and the public generally may not be deceived or tricked into withholding orders from us through fear of litigation, or into buying the batteries of the Accumulator company and the Consolidated Electric Storage company in the belief that they cannot procure and use, with perfect safety, our chloride accumulators, which we are manufacturing and selling under an absolute guarantee to protect and save harmless all users.

This company has not been enjoined from either manufacturing, selling or using its well-known chloride accumulators, nor has anyone been enjoined from purchasing or using them. The Edison Electric Illuminating company of New York has been enjoined by Judge Lacombe from installing our chloride accumulators as a part of its central station plant simply to maintain the *status quo*, pending the hearing and determination of the case in the Circuit Court of Appeals, upon the contention that the Edison Electric Illuminating company, having simply contracted for our accumulators, and not yet having actually installed them, should not be permitted to do so until the questions involved in the litigation should be finally determined in the United States Circuit Court of Appeals, especially as an appeal could be at once taken to and heard in that court on the 30th of October, and an early decision had thereon; and that was the view taken by Judge Lacombe, and upon which he acted.

Judge Lacombe's injunction has no other effect or significance and in no way affects this company's business of manufacturing and selling chloride accumulators, or of their use by purchasers, and was conditioned upon the accumulator company giving to the Edison Electric Illuminating company of New York, a bond in the sum of $20,000 to make good any loss which it should sustain resulting from the delay in installing our accumulators should the decision of the Circuit Court of Appeals be in favor of the Edison company, which we are advised and believe will be the certain result of our appeal to that effect.

We are advised by our counsel and experts, among them Prof. Charles F. Chandler of the School of Mines, Columbia College, Prof. George F. Barker of the University of Pennsylvania, Prof. Edwin J. Houston, president of the American Institute of Electrical Engineers, and Prof. Arthur E. Kennelly of the Medico-Chirurgical College of Philadelphia, that our chloride accumulator is not an infringement of any letters patent owned by either the Accumulator company or the Consolidated Electric Storage company, and that in their opinion the Swan re-issued letters patent are invalid and expired with the expiration of the Swan Danish patent in 1888; defenses which could not be availed of by us in opposition to the motion for preliminary injunction before Judge Lacombe, they having been previously passed upon by Judge Coxe in a former decision in the same court in the case of the Accumulator Company vs. the New York & Harlem Railroad company for the use of the so-called Julien battery, which battery was made in exact accordance with the plate of the Swan re-issued letters patent, and in which our chloride battery was not involved. Judge Lacombe held that on a motion for a preliminary injunction Judge Coxe's opinion was controlling and must prevail until the consideration of the case in the Circuit Court of Appeals, when those defenses would be fully heard and determined for the first time, as in the case wherein Judge Coxe sustained the Swan re-issued letters patent no appeal was taken, an agreement having been made between the Consolidated Electric Storage company, who was defending that case, and the Accumulator company shortly after that decision.

The facts are these, from which any intelligent person can draw his own conclusion: In December, 1890, this Accumulator company brought suit against us in the United States Circuit Court for the district of New Jersey, in which we appeared and made answer and thereafter, and down to the fall of 1893, no attempt was made to press the case, when it was finally abandoned, owing to our positively declining to further extend the time and demanding that the case proceed to trial. The Swan re-issued letters patent, upon which alone Judge Lacombe's injunction is based, was at that time owned by the Accumulator company, although they did not include it in that suit, nor did they after abandoning the suit, make any claim against our plate until August last, when the Edison Electric Illuminating company of New York selected our battery for central station for use in preference to any other battery in the world. Then, instead of bringing suit against us, they brought suit in New York against the Edison Electric Illuminating company, and applied for an injunction to force a temporary delay in the installation of a battery under our contract with that company. The work of preparing for the installation is going on and will be completed in time to install the battery upon the decision of the Circuit Court of Appeals, which we are confident will be favorable to us, and may be expected early in November. Swan's United States patent was applied for January 18, 1882, and was based upon an English patent to Swan of May 24, 1881, which expires May 24, 1895, at which time the United States letters patent will also expire, so this much-talked-of suit is based upon a patent which will expire in about seven months, and obviously was brought for no other purpose than annoyance.

There is no occasion for anyone to be annoyed or intimidated by threats of litigation from the makers of these inferior and condemned batteries, for we shall continue to manufacture the chloride accumulators, and furnish them under an absolute guaranty to all who require the best battery for all purposes now manufactured, and when the Accumulator company wants to enjoin us, they will have no difficulty in finding us, no more than did the Consolidated Electric Storage company who brought a suit against this company in January last in the United States Circuit Court for the district of New Jersey, accompanied with a motion for injunction, which, after full preparation, was heard at great length before Judge Green, and resulted in an opinion denying the motion for injunction, which opinion speaks for itself, having heretofore been published in the columns of this journal. Since then that suit has been dismissed.

We are ready at all times to fight out any supposed charge of infringement that either the Accumulator company or the Consolidated Electric Storage company thinks they have against us, but we object to their proceeding against our customers, which obviously is for the sole purpose of annoyance and intimidation—methods which reputable business men would not countenance. Let them proceed directly against us, when, if, they get an injunction, it will be of some value to them and the public will not be annoyed. All suits which they have heretofore brought against this company have been abandoned.

We say to our customers, and those contemplating the purchase of storage batteries, not to be intimidated or influenced by any threats of litigation, or any such public announcements as have been made based upon the above-explained decision of Judge Lacombe, as this company will stand between its customers and these attacks.

## Electric Propulsion of Canal Boats.

According to an Associated Press dispatch from Albany, October 8th, no special method of canals propulsion under the electric scheme proposed last spring has as yet been adopted, and it is doubtful if there will be any experiments made this year, as the canal will soon be closed for the season. Frank W. Hawley, one of the directors of the new company that has the right to string wires along the canal and is to furnish current to the canal boats for their propulsion, said:

"Many plans for canal propulsion have been submitted to us, and almost daily we are in receipt of communications from various parties who have suggestions to make and new ideas to offer. Whether we shall adopt any one plan in its entirety or evolve some new one from the excellencies of all, is still to be determined. The near approach of the date for closing the canals for the season leaves us several months in which to give the matter careful attention. We shall certainly take no steps that are not the results of earnest thought and serious deliberation. We propose to make our work a lasting benefit to the public, and of great utility to both shipper and carrier on New York's great waterway. While we are anxious to be in the field with cheap power at as early a date as possible, we shall best consult the interests of all by granting to inventive genius and our scientific and electrical experts ample time to perfect their ideas, and to present us with a system that shall combine at once the essentials of cheapness, simplicity and durability."

"Do you expect much opposition to the introduction to your power along the line of the canal?" Mr. Hawley was asked.

"Having secured by contract the right of way across the state for our cables, there can be no difficulty on that score. Whatever feeling of opposition to us there may be is occasioned, I am confident, either by the jealousy of rival interests or a lack of appreciation of the benefits to follow the introduction of cheap power.

"When we have brought it to the doors of consumers, and offered it on terms advantageous to them, self-interest will prompt them to accept it. We shall afford the thriving and energetic towns of Central New York an opportunity to develop their resources and increase their industries.

"No system of electric propulsion upon the canal will be seriously considered until after the representatives of the canal boat owners have carefully investigated it and unite in its recommendation. They will be the users of the power and they must be thoroughly satisfied in the method of its application."

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CORRESPONDENCE relating to electricity or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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HIGH WATER MARK

CIRCULATION, 16,630.

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THIS number of the WESTERN ELECTRICIAN is issued several days in advance of the regular day of publication, owing to the fact that it is devoted largely to street railway matters which will be of especial interest to the delegates to the American Street Railway association convention at Atlanta. That beautiful city is the center of interest just now for street railway men, and there is no doubt that its people will add to their fame as a hospitable community.

IT IS encouraging to note the evidence presented on all sides of the gradual improvement in business, particularly the renewed activity in electric railway enterprises. Many of the projects which were temporarily abandoned two years ago, on account of the stringency in the money market, have been revived and are now in fair way of being successfully exploited. Old roads are being rebuilt and improved, extensions are being made and new machinery introduced in the power plants. Manufacturers of electrical apparatus and dealers in supplies report encouraging signs of a revival of trade which will be welcomed by all who have suffered from the general depression in the industrial world.

CONVENTIONS of the American Street Railway association have come to be regarded practically as electrical meetings. The electrical engineer and the electrical supply man are very much in evidence; a majority of the companies forming the association are operating electric roads, and many of the papers read and topics discussed are of an electrical nature. President Lowry of Minneapolis certainly interpreted the signs of the times correctly when he said several years ago in his address to the association that electric propulsion would soon form the chief topic of interest at the conventions, and that the electric roads were bound to assume first rank, both in number and importance. To-day there is a verification of this prophecy in the Atlanta gathering.

CONSPICUOUS in the notable electric railway development of Chicago at the present time is the work under way for the Chicago City Railway company, which is described in a clear and interesting manner in this issue by Clement C. Smith. This company, with its 7,000 horse power, will have a power station as large as any in the country, and is taking a place as one of the great electric railway companies of the world. Perhaps the most interesting feature of the equipment, however, is the employment of a great electric motor to supplant two engines in the cable driving plant adjacent to the electric power house. This innovation will be followed with much interest, as it opens up an entirely new field for the utilization of electrical power, and one which, although somewhat limited in scope, will be entered without any exploitation by the electrical companies. More and more the electric motor is taking its place on the solid commercial plane of the steam engine.

IT IS not only the newspaper men of the United States who hear queer things about electricity; the writers for the British press chronicle developments fully as amusing and wonderful as anything that appears in the daily papers on this side of the water. A startling bit of information of this character was recently printed in the English *Pearson's Weekly*, in which the writer said: "I hear on good authority that those tram-cars in American cities worked by electricity will shortly be equipped with telephones for the use of passengers. The message will be carried on the overhead wire that supplies the motive power to the car, to the car company's headquarters, where it will be switched on to one of the telephone company's exchanges." The tantalizing feature of this information is its vagueness. We would like to know just where a trolley circuit is to be used for the purpose of telephoning. The company making this innovation should not be suffered to remain in modest obscurity.

OF COURSE no one can successfully controvert the assertion that the average electrical man is clean in morals, bright in intellect, shrewd in business, attractive in appearance and winsome in manner. What wonder, then, that he captivates the heart of the fair? Nor is it strange that he should exhibit ingenuity in planning his nuptials and the honeymoon, for his active mind yearns after end-of-the-century effects. To members of the electrical fraternity, therefore, it will be no great surprise to learn that an Indiana electrician—a superintendent of a central station plant and manager of an electric railway—designed his wedding (which, it must be confessed, was something in the nature of an elopement) so that the succeeding journey was taken on bicycles, which were made entirely by the bridegroom in careful preparation for the event. It simply shows a combination of latter-day elements that might easily be anticipated. An electrician and his bride flying over the country on home-made bicycles is a pleasing combination of love, science and mechanics, unterrified, exuberant and triumphant.

MEMBERSHIP in the American Street Railway association has grown to considerable proportions during the last few years, and a recent list issued by the secretary shows that there are now 180 companies represented, operating surface lines in 126 cities. These figures do not give an accurate idea of the power of the organization. Its influence can only be appreciated by those who are familiar with the character and standing of the companies forming the organizatton. It is hardly necessary to say that the successful street railway companies of the country, those which are managed by men of progressive ideas, who are always seeking improvements in methods of construction and operation, are prominently identified with this association. All of the larger cities of the country are well represented, New York, Chicago, Brooklyn, Philadelphia, Pittsburg and St. Louis having several companies in the organization. In examining the list of members one readily realizes why the meetings of the organization are so interesting and instructive. Every section of the country is represented, and in the exchange of views between members much valuable information is acquired which could only be secured otherwise by years of hard work and trying experiments. Then, too, the scope and character of the papers read, the discussion of practical questions of management, and the display of apparatus in actual operation, give additional value to the meetings. Time employed in attending these conventions is well spent.

IN the thickly settled districts of the East, the New England states, New Jersey and Pennsylvania particularly, several comprehensive systems of electric railway lines have been established, connecting small towns within a few miles of each other. In most cases the local street railway companies in these small towns have combined, and by extending their lines into the suburban districts, and building short connecting links, have been able to establish a complete network of railways. These enterprises have been highly successful in the East, and have attracted the attention of western capitalists, who, upon investigating the plans adopted in the East, have determined to establish at least one similar system in Illinois and Wisconsin. The first project of this kind that has come to notice is that referred to in another column of this issue. A company has been formed in Chicago for the purpose of building a line to be electrically operated, and extending from Chicago to Milwaukee. There are a number of prosperous towns on the way, but the distances between them are great as compared with those in the East, and there are other objections to be overcome. Yet the capitalists who are behind the enterprise are men of experience and sagacity, and they are quite enthusiastic over the project. It is promised that work will be begun at once, and its progress will be watched with interest.

WE recently remarked the curious perversity of fate in swelling the list of peculiar trolley car accidents. Another has now been added—this time in Philadelphia. An electric car was proceeding peaceably on its way at the ordinary rate of speed when the motorman in charge fell in a dead faint, with the result that the car dashed on without control, and was finally stopped by colliding with a wagon. Several persons were injured. There was no necessity for the accident, for the conductor, or any passenger, for that matter, could have stopped the car at once by pulling the trolley from the wire and applying the brake. The conductor must have become demoralized from fright and should be severely disciplined. The human equation is as much a factor in electric railway travel as on steam roads or steamboats.

In commenting on this case the *Philadelphia Record* takes a very sensible view of the whole subject. It upbraids the conductor for his criminal incompetency and makes these observations:

Before any employe shall be put in charge of a trolley car, or set at work in the supervision of electric lighting, stringing of wires or of repairs, he should be thoroughly instructed in such fundamental knowledge as is necessary for the protection of himself and others. As a rule, the present generation know that they cannot safely blow out the gas or touch fire to gunpowder. There should be similar general knowledge of the dangers inherent in the use of electrical energy. We cannot do without it; but we must train ourselves to the means of safely using it.

The last sentence in this quotation is especially valuable. It would be a source of better feeling all around if other daily journals accepted the obvious truth of this principle in dealing with the development of electric street railways.

THAT there has been considerable advancement in the application of electricity to elevated railroad work is evident from the attention which the subject is commanding at the present time. Mr. Arnold, whose experience in connection with the Intramural road at the World's Fair has placed him in a position where he can speak authoritatively, says that the advantages to be derived from this system are such that steam locomotives cannot hope to compete with the electric motor. His interesting article in this issue contains some valuable figures, which will be very acceptable to those who are interested in this investigation.

Mr. Arnold reviews the history of the experiments made on the "L" road in New York by Leo Daft, the more successful applications at Liverpool and Chicago and predicts that the elevated road of the future will be built of steel, at least one-third lighter than the present structures for steam service. The current will be carried to the trams by means of a trolley line consisting of a cheap grade of railroad rails, which it has been found can be purchased and laid for but little over half the cost of copper conductors of a given conductivity, or by a special rolled square steel bar. The active or "live" trolley will be supplemented by one or more similar rails, or bars, as the distance from the power house and number of trains increase. Sliding contact trolleys have thus far proven preferable and will probably be adhered to for future work at higher speeds. The direct current motors attached directly to the axles of the forward or motor car will be retained. The idea of having a separate electric locomotive for elevated work seems inadvisable for several reasons.

## How and Where Paranite Insulation Is Made.

EVERYBODY knows that rubber is an excellent insulator, and that in the manufacture of insulated wires and cables its presence is well nigh indispeosable, but the source from which commercial rubber is drawn, the processes to which it is subjected to prepare it for this application, and many of the details of the successive steps in the transformation from the rough state to the fine flexible form in which it is used, are not so generally understood. As an illustration of fine practice in the handling of rubber and the manufacture of high-grade insulated wires and cables, the factory of the Indiana Rubber & Insulated Wire company at Jonesboro, Ind., is an interesting and complete example. The plant, which is fully illustrated in the accompanying pictures, is located in the natural gas belt of Indiana and about six miles from Marion.

Fig. 1. Mixers.
Fig. 2. Calender.
Fig. 3. Cutting Machine.
Fig. 4. Insulating Machines.
Fig. 5. Braiding Room.
Fig. 6. View of Second Floor.

HOW AND WHERE PARANITE INSULATION IS MADE.

The company owns about 80 acres of land surrounding the factory, upon which are a number of valuable gas wells, which furnish cheap fuel for the operation of the plant and make the land particularly adapted for manufacturing purposes.

It is the intention, in this article, to follow the successive steps of converting the crude rubber into the finished insulation and to explain the process of covering the bare conductor as practiced by the manufacturer of the Paranite compound, consequently it will be necessary to first proceed to Brazil in the region of the Amazon river and to ascend this mighty stream into the interior. The rubber tree of Brazil, technically the *siphonia elastica*, is really a giant species of milkweed. When about fifteen years old it begins to yield a sap, closely akin in general appearance to cream. The native sap hunter penetrates the forests of the country and taps his rubber trees in a manner similar to that employed in tapping maple trees in this country for their sap. He makes a number of fresh cuts around the trunk of each tree as he goes his daily rounds and places his little clay cups to catch the valuable sap that will ooze from the incision. Later in the day he repeats the round, carrying a bucket made from a big gourd, or of clay, and into it he empties the collected contents of all the little cups. When he gets back to his camp he pours the juice from the gourd into a large basin. The native builds a smudge of palm nuts and dips a stout stick into the gum and then holds it in the thick smoke of the burning nuts. The dense white smoke hardens the gum into a leathery substance and at the same time changes its color from pale yellow to black. This ball is then dipped again into the sap or gum and the action repeated continuously until the solid mass on the end of the stick is too heavy for further manipulation. In form it resembles a cheese, and when the stick is withdrawn it is placed aside to dry, and eventually is shipped to other countries. It is in this form that it is purchased as crude Para rubber by the Indiana company. The city of Para is the chief center of the rubber interests in Brazil.

The "biscuit," as the rubber is termed when received at the factory in the same shape as when imported, is cut into several pieces and placed in a large hot water vat, where it soaks for twelve hours. At the expiration of that time it is sufficiently prepared to be passed through sets of corrugated rollers, upon which a stream of warm water constantly plays. This process reduces the rubber into long, thin strips and removes all impurities which are frequently found in the native product. It is then hung for several months in a dark room, where an average constant temperature of 100 degrees is maintained. In this form the substance is the absolutely pure rubber gum. After it has hung for a sufficiently long time to become thoroughly seasoned it is taken in long strips to the mixing room, Fig. 1. The mixer rolls which are shown in the illustration, are six in number and each consists of two rollers, operating under great pressure, one roller moving faster than the other in each machine, so that the rubber may be thoroughly and constantly ground. Powdered sulphur and the other ingredients used to bring out the best qualities of the rubber for insulating purposes are sifted into the moving materials. Two compounds are thus prepared, one differing from the other only in the absence of sulphur. Two coatings of rubber are used in the Paranite insulation, and the preparation which is to be next to the conductor is free from sulphur so as to avoid the possibility of oxidization. It is white, while the preparation which is to form the second coating is at first of a brick red tint. These coatings are possessed of great toughness and flexibility, and afford a considerable degree of resistance to abrasion. The rollers are four and one-half feet long, each cylinder being 16 inches in diameter. Adjoining the room containing these machines is the room where the ingredients mentioned are mixed. After the product has been sufficiently well ground and mixed it is made into rolls and placed upon shelves to dry.

The machinery used in the next step is shown in Fig. 2, and consists of a calender of three rollers and an endless belt which carries the rubber, sheeted by the operation of the calender, to a cutting machine on the floor above. The calender is adjustable to the most delicate measurements and sheets the rubber to the required thickness for the particular size of wire being made at the time. Another view of the endless belt is had in Fig. 3, which includes the cutting machine on the floor above the calender. Here the rubber in sheets is fed under a revolving cutting wheel and divided into a number of strips proportionate to the width required. Bundles of strips are carried to the six insulating machines shown in Fig. 4, five of which put double coats upon the wire and the remaining machine only one coat. Wire turned out by the latter is of course used for special cases, where only one coating of insulation is preferable.

The copper conductor purchased by the company, after being tested for determination of conductivity, is taken to the tinning room, where it is run through, first, an acid bath to thoroughly cleanse it, then through melted tin, finally through a bath of cold water, and is coiled upon a drum. Thence it is taken to the insulating machines and is run off the drum and through the machines, where the insulating compounds are coated over it. The rubber compound is fed into the machines in strips of predetermined width, grooved wheels pressing it upon the conductor and cutting off superfluous material. The insulated wire is now rolled upon reels and taken to the braiding room upon the third floor, Fig. 5. This department occupies the entire floor and contains three doublers and winding machines and fifty single-deck and five double-deck braiders, some of which are of extra large size for braiding large telephone cables. The system of automatically unwinding the unbraided wire and rewinding it, when braided, upon spools is clearly shown in the picture. The braided wire is taken from the third floor to a vulcanizer upon the second floor, where the wire, rewound upon very large drums, is subjected to a temperature of 320° F. This process turns the brick colored compound black. Fig. 6, a general view of the second floor, shows the finishing step in the process of manufacture in the foreground, that is, tanks of a pitch preparation fo

coating the braided surface of the wire, for coloring it black and giving it its customary finished appearance.

The wire, measured into the desired lengths, is ready to be tested, and as a preliminary trial it is thrown into a lead lined tank filled with water kept at about 75° and allowed to remain over night. Upon the next day the coils are tested by means of the instruments shown in the testing room, Fig. 7, in a small brick building in the rear of the factory. Here the tester for the company, E. U. Weygandt, has installed the usual testing instruments, including a reflecting galvanometer, a Wheatstone bridge, resistance box, etc. A battery of Samson cells furnishes 200 volts for testing the wire while in the water. As a final test, a magneto bell is placed in circuit between the ends of a coil of wire. These precautions are taken upon every coil of wire that issues from the factory, and have done much to raise the company's reputation for the reliability and excellence of its product. The Massachusetts Electrical Engineering company, Boston, Mass., made a test, some time ago, upon some No. 14 Paranite wire selected from store stock, and in its report asserted that the test was made with 550 volts, at three minute electrification on continuous immersion without interruption for 13 days. During the last three days the test was made while the wire was buried in lime. The report showed that 25,000 megohms per mile were obtained each day under all conditions.

Fig. 9. Engine Room.
Fig. 10. Office at Marion.
Fig. 7. Testing Room.
Fig 8. Factory.

HOW AND WHERE PARANITE IS MADE.

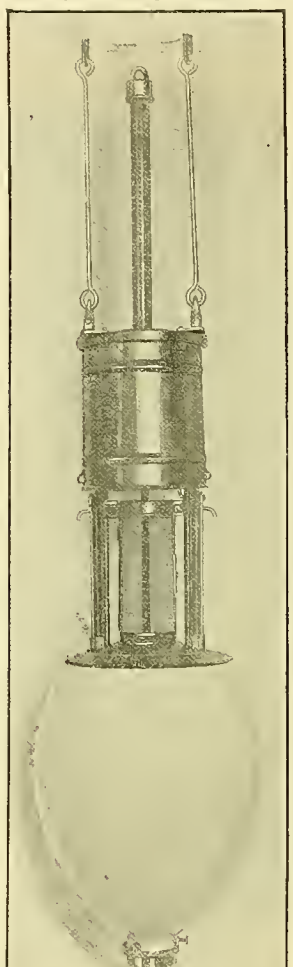
The factory itself, as seen in Fig. 8, is a well lighted building, three stories in height, and built entirely of brick. The main body of the plant is about 60 by 200 feet, but in addition to this there is the engine room, the boiler room, tinning room, rubber washing room, testing house and tank for the immersion of the wire while testing. Natural gas is piped from the company's wells near at hand to the boilers, four in number, and of 100 horse power capacity each. Steam is furnished by an eight-inch pipe to a Corliss single condensing engine, manufactured by the Ranken & Fritsch Foundry & Machine company of St. Louis. It is rated at 300 horse power at 74 revolutions a minute, and supplies the power for the entire factory. The engine-room, including the engine and several dies and lathes, is shown in Fig. 9. The rubber washing machines, as well as the mixing machines, are operated by shafts geared directly to the engine shaft, but the remainder of the plant is furnished with power from belt and intermediate shaft transmission. The entire building is provided with the Grinnell automatic sprinkler system, and is in many respects of particularly meritorious design. A switch of the "Big Four" road has been run to it, and as it is only a short distance from the Pennsylvania line, it will be seen that it is amply provided with excellent shipping facilities.

The factory of the Indiana Rubber & Insulated Wire company is of more than ordinary interest to the readers of the WESTERN ELECTRICIAN, because it is the only rubber insulated wire factory in the West. It is a western enterprise, and has shown a typical western progressiveness and push in overcoming discouraging circumstances which threatened its early career, and in fighting its way, in the face of the most severe competition, to the prominent place which Paranite has attained in the electrical business. The company was organized in 1890 and secured a charter under the laws of the state of Indiana. It early made fair dealing and an honest product its policy. As may be judged from this article, no secret process is claimed. From the sap collected in the forests of Brazil to the final test at the factory only the best material is used, and a strict care is exercised that only the best results may be obtained. The company has decided to confine its operations mostly to the manufacture of rubber-covered wires made from the Paranite compound and especially adapted to work requiring a high grade of insulation, where absolute safety is the first consideration and where the best is always the cheapest. By applying itself exclusively to this field and eliminating from its list several other lines of cheaper insulation, it is permitted to place at the disposal of its Paranite trade the full equipment of its factory, together with a large and complete stock of all regular sizes kept constantly on hand. Although this article has been more descriptive of an ordinary gauge of wire, there is much machinery in the factory intended for the manufacture of underground and submarine cables, and every facility is possessed for turning out this class of work.

The office of the company is located at Marion, Ind., from which there is telephonic communication with the factory. One of the rooms is shown in Fig. 10—a view including the desk of C. J. Butler, the secretary and manager of the sales department. Mr. Butler's face is a familiar one to the electrical trade interests of this country, and his name is synonymous with the growth of the popularity of the Paranite insulation. In March, 1892, he was called from a bank in Akron, O., to take charge of the financial affairs of the company, and his management has placed the concern on a firm basis. Previous to his connection with the bank, Mr. Butler was associated with the Diamond Match company of the same place, and it was there that he gained his manufacturing experience and practical business knowledge. Mr. Butler is 32 years of age, and very popular in electrical circles. The company has established agencies with the Hess Electric company, Des Moines, Ia.; the Gate City Electrical Supply & Construction company, Atlanta, Ga.; the Electrical Engineering company, Minneapolis, Minn.; W. J. Osborn & Co., Kansas City, Mo.; the Post-Glover Electric company, Cincinnati, O.; the Cleveland Electric Manufacturing company, Cleveland, O., and the Electric Appliance company, Chicago. The last named company makes Paranite wire one of its most prominent specialties. An illustrated description of this company and its work is presented elsewhere in this issue. The Indiana company has established an eastern sales department, with F. W. Brigham in charge, and with offices in Boston and New York. The officers of the company are: President, J. H. Seiberling; vice-president and treasurer, M. Seiberling; superintendent, A. F. Seiberling; secretary and manager of sales department, C. J. Butler. J. H. Seiberling is a very successful manufacturer in Doylestown, O., but devotes much of his time in looking after the welfare of the Paranite interests. He, with his son, A. F. Seiberling, the superintendent of the factory, has been identified with the company since its organization, and has been largely instrumental in bringing the manufacturing department to its present state of perfection. Monroe Seiberling is a manufacturer known all over the gas belt, where he is interested in many enterprises.

## Thomson '93 Alternating Arc Lamp.

When the large percentage of lighting circuits in this country operated by alternating current is considered, it is a matter of surprise that more satisfactory alternating current arc lamps have not been presented to occupy part of the immense field of service and utility heretofore exclusively covered by the alternating incandescent lamp. To satisfy a demand that has become general the General Electric company has placed upon the market a modification of the Thomson '93 arc lamp shown in the illustration, adapted to the alternating current circuit. To bring this lamp to its present condition has taken months of experiment, but the result is such as should render alternating current arc illumination equal to that by the continuous current arc lamp, whether for indoor or outdoor service. With the Thomson '93 alternating lamp no external or wasteful resistance is employed; the feeding mechanism is positive, the parts durable and interchangeable and the regulation perfect. In principle the feeding mechanism is a rack rod and escapement operated and controlled by an entirely new method. The rack rod is free to move in both directions without strain on the escapement. The arc is started without "jumping." The mechanism is simple in the extreme, and requires no adjustment before installation. All the different styles of lamps, standard, short, focusing, etc., are provided with reflectors and spark arresters. The globes may be lowered rapidly and the carbon dust speedily removed.

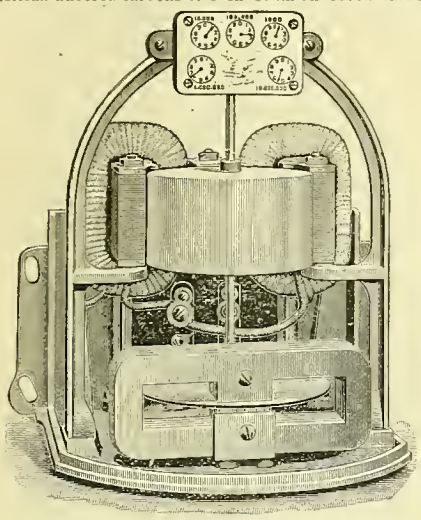


THOMSON '93 ALTERNATING ARC LAMP.

These alternating arc lamps of a nominal 2,000 candle power are designed for a current of 13 amperes and are ad-

justed for that current unless otherwise desired, to be connected in parallel on 32 volt circuits. Each is an absolutely independent unit. The 32 volts can be obtained from the secondary of the transformer, and such transformers wound for 32 volts in the secondary, and of desired capacity, will be furnished by the General Electric company. It is evident that the great commercial advantages attendant on incandescent lighting by alternating current equally exist for the alternating arc lamp. If arc lighting alone is to be undertaken, the 2,080 or 1,040 volt dynamo feeders run to a central point of distribution, thence the mains carry the current to the transformers, from the secondary of each of which one or more lamps may be operated. In the case of the 2,000 volt primary circuits there will be but ¼ ampere per lamp, and in the case of the 1,000 volt primaries ½ ampere per lamp. Thus the line losses are reduced to a minimum. Four hundred and twenty-five watts is the quota of energy for each standard lamp of 13 amperes and 32 volts in calculating for the transformer capacity to be installed or permissible number of lamps to be run from transformers already installed but only partially loaded. In the latter case compensator coils may be used for changing the 52 or 104 volts usually for incandescent lighting to the 32 volts required for the arc lamp, the change being effected in the compensator coil with practically no loss of power.

With any alternating current arc lamp the exclusive use of cored carbons designed for alternating current lamps is essential. With the standard lamp 9½ by 7-16 of an inch or ½ of an inch cored carbons are used, giving a life of from nine to ten or eleven to twelve hours respectively. With the short and focusing lamps, if about the same life is required, 7 by 9-16 of an inch cored carbons are used. American uncored carbons or even common cored carbons



SCHEEFFER'S RECORDING WATT METER.

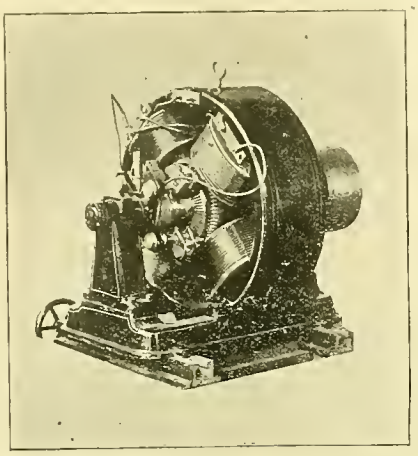
designed for direct currents cannot be used, and, moreover, their use would prove very expensive because of the increased potential which they would require (over that required for soft carbons) when used for alternating current work.

## Scheeffer's Recording Watt Meter.

Scheeffer's recording watt meter, as the accompanying illustration shows, consists of a multipolar magnet, made from laminated iron and having three polar surfaces. On one polar part of the magnet is a coil of thick wire, which carries the main current to be measured, and on another polar part is a coil of fine wire placed in derivation between the distribution terminals. In front of the polar surface of the multipolar magnet, and embraced by one-half of the circumference, is an aluminum cylinder, mounted on a vertical shaft, resting in a jeweled bearing below, and guided by an upper bearing. On the upper end of the shaft is an endless worm, which engages the registering trains, so that the rotations of the cylinder are recorded, and on the lower end of the shaft is placed the retarding device, which is an aluminum disk at right angles to the shaft and made to rotate with it. The disk rotates between the poles of a permanent magnet. The action of the coils causes the cylinder to rotate, the speed of rotation being directly proportional to the current. The friction is balanced in this meter by very simple means, consequently the meter reads correctly at all loads. The meter has no commutator or brushes. The valuable point possessed by this meter is that it records real watts and not apparent watts. The readings are given direct in watt-hours, so that no mathematical calculation is necessary to determine the amount of energy delivered during a given time. The current required to operate this meter is very small. This sensitiveness is produced in part by the reduction of the friction to its lowest limits. Corrections and adjustments to the exact speed is made by simply moving the cylinder up or down on the shaft. The simplicity of this meter is such that there is little to get out of order or become disarranged, and by proper care the meter will require practically no attention, no repairs, and the record will be thoroughly reliable without the necessity of frequent adjustments. It is placed upon the market by the Diamond Electric company, Peoria, Ill.

## Zahn's Multipolar Dynamo.

Dr. G. H. Zahn is the designer of the multipolar dynamo and motor shown in the accompanying illustration. As will



ZAHN'S MULTIPOLAR DYNAMO.

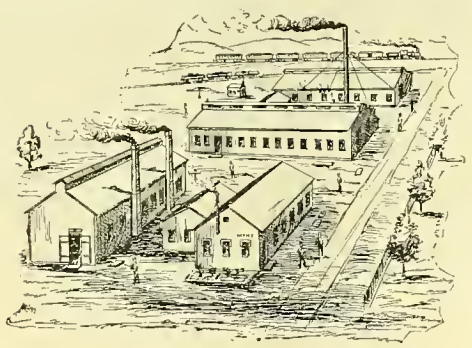
be readily seen, great care has been taken to produce an artistic design, a solidity of construction and a close adjustment of proportions within the machine.

The magnet frame is of the ring shape and cast in one piece, insuring a good magnetic circuit and great mechanical strength. The armature is of the Gramme ring type, and carefully annealed sheet iron rings of the best quality are used in building up the core. These rings, after being insulated, are clamped between two halves of a bronze spider, held together by steel bolts in the interior of the core. The commutator is of massive design, made of tempered copper and insulated with mica exclusively. The shaft, of the best machinery steel, is run in self-oiling phosphor bronze bearings.

This new line of standard machines brought out by the Electrical Manufacturing company of Corry, Pa., is of high efficiency and guaranteed to be free from defects of workmanship and material and to run with automatic regulation without sparking and injurious heating.

## The W. S. Hill Electric Company's Heavy Current Switches.

The accompanying illustration shows the new switch manufactured by the W. S. Hill Electric company for railway and central stations. For the last year these switches have been in use in very large numbers, one power station



THE PARTRIDGE CARBON COMPANY.

alone having over 300 in use, of from 500 to 4,000 amperes capacity. The improvements (which are covered by patents) consist in broadening the ends of the blades and yoke so as to admit of using two bolts. This unites the two so firmly that it prevents all twisting or straining of the parts while the switch is being operated.

The method of backing up the flexible brush contacts by plates of pure copper, practically converts the blade and contact into one continuous piece of metal, and as the size of all the carrying parts is computed at 1,000 circular mills per ampere, the advantages of this construction are apparent.

The Mayfield, Cal., & Leland Stanford, Jr., University Street Railway company has been incorporated with a capital stock of $10,000. The president is J. P. Ponce of Alexander, Cal.

## The Partridge Carbon Company.

The Partridge Carbon company of Sandusky, O., is now giving its entire attention to the manufacturing of motor and generator brushes for all systems, and promises goods of the best quality. The superintendent of the company, Mr. Partridge, is one of the oldest carbon manufacturers in this country; in fact he has given his entire attention to it for the last seventeen years, and is competent to make any kind of a brush that may be desired, from the smallest fan motor brush to the largest dynamo brush. The factory of the company is shown in the illustration.

# CORRESPONDENCE.

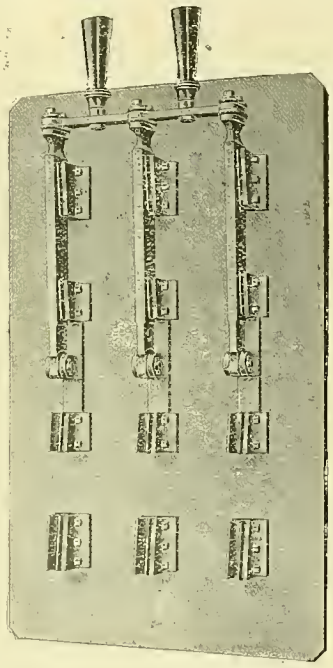
## New York Notes.

NEW YORK, October 12.—Considerable interest has been taken in the report submitted to the Rapid Transit Commission recently by its engineer, Mr. Parsons, mention of which was made in this correspondence last week. In closing his report Mr. Parsons enumerated the conclusions drawn by him as the result of his trip abroad for the purpose of investigating different systems of underground railway construction. The conclusions arrived at from such investigation, both from the study of the actual work and from personal interviews with their designers, are:

First—That an underground railway operated by steam, even with the most approved system of mechanical ventilation, would be intolerable to the people of the city of New York.

Second—That a railway with a steady, frequent service can be operated successfully and economically by electricity.

Third—That an underground railway operated by elec-



THE W. S. HILL ELECTRIC COMPANY'S HEAVY CURRENT SWITCHES.

tricity has a comfortable atmosphere, and that it can be arranged so as to avoid great changes in temperature.

Fourth—The advice and experience of foreign engineers lean toward keeping the rail level as close to the surface as possible, and that excavating from the surface is safer and cheaper than tunnelling; but,

Fifth—If conditions demand, a deep tunnel can be constructed, for which the circular form is best.

Sixth—That an underground road can be so designed as to be attractive in appearance.

Seventh—That the work can be carried on through a busy street without endangering the houses and without seriously impeding travel.

These conclusions presage, in the event of a favorable rapid transit vote by the people at the coming election, the construction of an underground electric road, and further steps in that direction will be carefully watched.

The people of Trenton, N. J., may have to walk for a time, for the common council has passed a resolution to the effect that unless the Trenton Passenger Railway company gives a system of five-cent exchange tickets, as provided for in an ordinance, the cars must be stopped. Colonel Lewis Perrine, the president of the company, has had several extensions of time so that he could perfect a system of exchange tickets, but the people are becoming impatient and demand that the law be enforced. The resolution demands the five-cent fare, and if it is not given, the mayor is requested to call on the police and see that the cars are all stopped. Colonel Perrine is determined that the cars will run, notwithstanding the mayor and police. He interprets the ordinance differently from the council and declares that he will not provide a five-cent exchange system.

W. F. O.

## Milwaukee, Wis.

MILWAUKEE, October 12.—The question as to whether the new city hall shall have a lighting and heating plant of its own has been virtually decided in the affirmative. Charles G. Armstrong of Chicago appeared a few days ago before the common council committee on city hall and library and gave an approximate estimate of the cost of a lighting and heating plant in the city hall building. His estimate was much lower than any which the committee had received. He made careful figures on a duplicate plant and said that a close estimate of the cost of the whole property would be $71,478, which would include all the running expenses for the first year, even to the salaries of the employes. The most important items in Mr. Armstrong's estimate were $24,000 for the dynamos for 12,000 electric lights, $15,000 for two Corliss engines and $4,000 for the boilers. These figures, he said, provided for the best and most improved appliances. Mr. Armstrong was sure that the employes in the building would not be annoyed by the vibration from the engines or by the heat from the boilers. The estimate which had been made by the managers of the Pabst power house was $86,380. In view of the fact that the boilers cannot very well be put in after the building is completed, it was thought best by the committee to have them installed at once. No definite decision was reached in regard to the rest of the plant, but inasmuch as the boilers cannot be used for any other purpose than to furnish power for heating and lighting the building, there is no resonable doubt that the committee will eventually report in favor of putting in the entire system.

City Clerk Anderson has secured figures from Chicago in regard to the cost of electric lights in that city. The report in substance is that during the year 1893 the city of Chicago operated 1,100 2,000 candle power lamps from four power stations at a cost of $107,277.93, an average cost of $96.64 per lamp. J. P. Barrett, city electrician of Chicago, writes as follows to Mr. Anderson: "In regard to depreciation, I beg leave to state that in a city like this it is extremely difficult to arrive at any fair percentage which should be charged up for depreciation. We dispcsed of a building, dynamos, engines and other apparatus at cost price after they had been in service several years, and the land on which they were located at abont 25 per cent. more than its cost price. We must keep all of our apparatus in good working order, so that it is practically as good as new. So, taking everything into consideration, we do not allow for depreciation." Capt. George Derley, a United States engineer who is stationed at Washington, D. C., writes as follows: "The whole question of municipal ownership hinges upon whether the plant can be operated on business principles or whether the circumstances are such that politics will interfere with the management. In the former case, with competent management, I am confident that municipal ownership will pay richly." W. F. Conant, secretary of the commission that is building the municipal lighting plant at Detroit, makes the following statement: "I doubt if you can show any very great saving by the erection of a municipal plant. When you come to add to the cost of operation the interest on the investment, the loss in taxes and the depreciation each year, I doubt if you can do much better than $100 per light." Milwaukee now pays $112.50 per lamp.

Vice-president Henry C. Payne recently made a statement regarding the proposition in the common council that the city buy and operate the street railway system of the city. "I do not own the street railway," said Mr. Payne, "but I am willing to sell my share, and so, I expect, will the other stockholders, if we can agree on the price. Of course no one individual owns the plant, and if any of the stockholders are unwilling to sell their interests they have a right to hold on. I suppose that all will be willing to sell if the price be agreeable." At the same time Mr. Payne did not appear to have much confidence in the talk of the city buying the street railway. Nobody had broached the matter to him in behalf of the city, and all that he knew about it was what he had read in the papers.

The subscribers to stock in the Waukesha Beach Electric Railway company held a meeting last Saturday. It was reported that the right of way for a distance of four miles had been secured at a cost of less than $5,500, and that only another mile of right of way remained to be secured. The line will enhance the value of the property near which it runs; and there has been a strong rivalry among some of the owners of Waukesha property. The contract for doing the grading and building the culverts has been let and the work has been begun. This part of the expense will not exceed $5,000. The question of the amount of land to be taken was left to a committee consisting of A. J. Frame, D. C. James, Judge F. H. Putney, H. M. Youmans and F. W. Harland, to act in conjunction with the recent purchasers of land on the lake front. The capital stock of the company is $40,000 and it has all been subscribed. The road will be running by the end of next spring.

There is some talk of appealing to the state legislature to fix the charges for telephone service. The old style telephones cause a great deal of trouble, and the Wisconsin Telephone company makes an additional charge for metallic circuits. It is the expense of metallic circuits that is causing complaint.

The village board of South Milwaukee is considering an application from the Wisconsin Telephone company for a franchise for a telephone exchange in the village.

Vice-president Henry C. Payne and General Manager Wyman of the Milwaukee Street Railway company will attend the annual meeting of the American Street Railway association at Atlanta next week. Mr. Payne is president of the association.

Walter Smith has been appointed mechanical engineer of the Milwaukee Street Railway company, and assistant to Superintendent Lynn. Mr. Smith has been connected with the road for a number of years. He was engaged in the construction department. The position to which he has just been appointed is a new one.

The proposition to run electric cars across the Holton street viaduct has given the electricians a problem to solve. The draw of the viaduct is constructed in such a manner that while half drops on each side, a quarter section projects upward, and prevents horses and pedestrians from walking off into the water. General Manager Wyman says that the track question can be solved by means of hinged joints, but that the overhead system will be puzzling. He says that the wires and posts will have to be so constructed that they will fold with the draw.

The Milwaukee Street Railway company has purchased an armored cable of 122 strands to carry power for the South Side electric lines. The cable is 7,417 feet long. It cost $10,000 and it will cost $5,000 more to lay it. It will be laid underground along East Water street, across the river and thence to Reed street and National avenue. The work of putting down the big cable will be begun November 1st.

Edward Schuengel, one of the city officials who attended the recent public works convention in Buffalo, has become a strong advocate of heavy rails for street car lines. He states that experience has shown that the character of the rail has much influence on the durability of street pavements and that only the heaviest rails are being put down in Buffalo and in other eastern cities. The rails now used in Buffalo are nine inches high and weigh 94 pounds to the yard. Mr. Schuengel says that the manager of the Buffalo street railway told him that these heavy rails were much cheaper in the end because they are firm as a rock and wear almost as long as the track is used. In Milwaukee 5-inch and 7-inch rails have been used. When the 7-inch rails were put down it was thought that they were remarkably heavy. The rails used in Buffalo are heavier than the average rails which are laid on steam railways.

The Milwaukee Street Railway company is tearing up the tracks on First avenue and taking down the poles and the wires. The material, which has never been used for the operation of cars, will be used on Vliet street.

The trouble between the Milwaukee Arc Light company and Frederick Raymond and the other employes who were discharged by the company has been settled by arbitration. The Federated Trades Council took a hand in the matter, and finally all of the men except one were given their old places. The one man who was not allowed to return had secured employment elsewhere.

An ordinance has been introduced in the common council to compel the Milwaukee Street Railway company to carry people for 4 cents a ride between the hours of 6 and 8 in the morning and 6 and 8 in the evening. General Manager Wyman states that the question involved is a very serious one. The only case of the kind that he knows of, he says, was in New York, where the elevated roads established a 5-cent rate for workingmen. It was found that the concession congested traffic. People would wait fifteen and twenty minutes in order to get the reduced rate, and the company finally made the 5-cent rate uniform. Mr. Wyman says that if cash were accepted on the cars, the company would not know what its conductors were doing, and that if tickets were sold the situation would not be much better. The company would have to carry 4-cent passengers and 5-cent passengers at the same time, and disputes would arise whenever the watches of the passengers and the conductors did not agree.

The Fort Howard electric railway is being built rapidly. The grading on half of the distance of three miles has already been done, and the work of laying the rails is in progress. The power house is about completed. It will contain two engines of 100 horse power capacity each. These will drive two dynamos, one for the electric railway and the other for the lighting system. Three cars will be run on the line at the start. Mr. McCartney, the owner, will furnish 33 arc lights to the city of Fort Howard and about 1,000 incandescent lamps for private use.

The new power house at the National Soldiers' Home will contain an electric light plant, an annex 50 by 70 feet being provided for it. The steam pipes and electric light wires will be connected with the main buildings by means of a tunnel.

The common council committee on railroads has placed on file the ordinance requiring street car conductors to guard the trolley poles at steam railroad crossings instead of going in advance of their cars and seeing whether there is danger.

The common council of Appleton did not pass the ordinances to permit the Inter-urban Electric Railway company to build through that city. The matter came up at a regular meeting, the committee reporting the measure without any recomendation, although it had had two months in which to consider the question. At the adjourned meeting in which the ordinance was defeated, there was only a bare quorum. Public sentiment was in favor of granting the franchise, however, and strong pressure was brought to bear upon the council when the measure was introduced again. The result was that at a special meeting held on October 10th, the committee agreed upon a route and the franchise was granted by a vote of 11 to 1. The line is destined to run from Oshkosh to Kaukauna. C.

## St. Louis, Mo.

ST. LOUIS, October 11.—Charles Green, president of the People's Railway company, is making preparations to change the Fourth street and Arsenal horse car division of that road into an electric road. A franchise authorizing this change and also authorizing an extension of the road northwardly on Fourth street to its intersection with Third street near Car street, with a loop terminus at that point, was granted last year. This franchise is notable from the fact that it permits the erection of a trolley line on Fourth street through the center of the city and therefore seems to open the same privilege to all other lines which desire to construct trolley lines through the central part of the town. The main line of this road is a cable road, and it is likely that this also will be changed to a trolley road at an early date.

The St. Louis Underground Service company has made application to the Board of Public Improvements for the privilege of extending its subway on Broadway from St. Charles to Franklin avenue and also for the construction of a subway on Fourth street from Pine street to Franklin avenue, with lateral subways on the intervening streets.

R. J. H.

## New England Notes.

BOSTON, October 10.—The Boston board of aldermen at its last session, through several of its members, made a vigorous attack on the West End Electric Street Railway company, and as a result a measure was passed prohibiting the road from carrying freight. At a previous meeting an order had been introduced prohibiting the West End Way from carrying any freight, and the committee on railroads, to which the order was referred, reported "no further action necessary." Then came the rumpus, which resulted in the report of the committee being accepted and then the passage, under the suspension of the rules, of an order prohibiting the road from carrying freight on and after October 8th. The board took further action in regard to the West End road by ordering that the committee on streets and sewers give public hearings on the following points:

First—Directing that both gates shall be closed on the forward end of any electric car when in motion on any highway in Boston.

Second—Prohibiting any person except the motorman or conductor from being on the front platform of any such car during its passage through the city.

Third—Directing the West End Street Railway company to immediately connect its third track on Tremont street, in front of the Granary burial ground, at its northerly end, with the adjoining track, and forbidding any car to stand on said third track or to be started therefrom in a southerly direction; such prohibition to stand until the company shall provide a suitable waiting-room for passengers on Tremont street, between Winter and School streets.

Fourth—Directing that all open cars shall be closed by rails or other devices on one side, so that persons cannot enter or leave the car on such side; also prohibiting all persons from riding between seats on open cars.

Fifth—Regulating the length of electric cars and insisting on suitable fenders.

Other resolutions were passed referring to the removal of all unused tracks.

The West End company is adding daily to its equipment. Its latest addition in the line of rolling stock consists of two palace cars, perhaps the finest examples of purely street conveyance ever seen in this or any other city. The trial trip of 19 miles was made October 8th, road officials and newspaper men making up the party. The bodies of the cars are 20 feet long, by 7 feet 4 inches wide, and the motors 25 horse-power each. The outside colorings are black and gold relieved with crimson in the panels. The running gear is painted a dark green and is in no way different from that of the ordinary cars that have recently been added to the rolling stock of the company. Inside, the

Western Electrician.

EVERY SATURDAY.

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## Storage Battery Locomotive in a Factory.

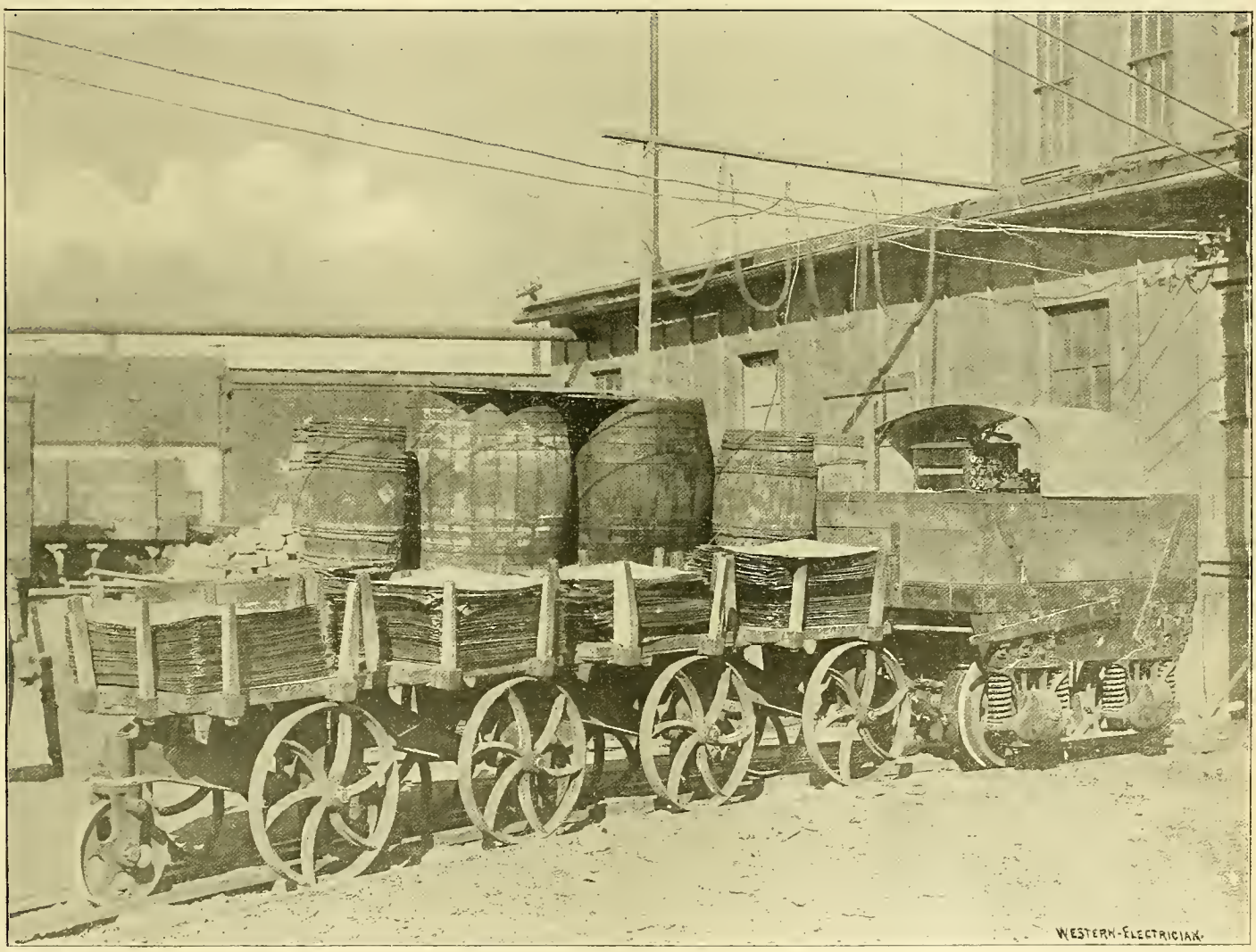
This journal has had occasion to call attention several times of late to interesting storage battery installations, most of which were used in connection with lighting plants. In the accompanying illustration upon this page is shown another battery application, which may present a possible solution of many troublesome problems which confront mill and factory owners, who, while desiring to do away with expensive manual labor in hauling materials from one point to another, are confronted by conditions which render "dummy" roads, cable or electric trolley lines impracticable.

Such conditions were experienced at the tin plate factory of Norton Bros., at Maywood, a suburb of Chicago. The establishment consists of a number of buildings rather widely separated from one another, between which it is necessary to carry the heavy products of the different departments. Hitherto men have been employed to drag handcars, heavily loaded with sheets of tin plate, by hand from factory to factory. For many reasons this system was a clumsy one. Several men were required to handle each car, and their wages alone made an important factor in the operating expenses of the establishment, while their progress to the extreme parts of the plant was necessarily slow. When it was decided to substitute some mechanical power for manual, the electric trolley system naturally suggested itself, but a live wire running through the rooms of the factories and upon their several floors (for the machinery as installed necessitated the conveyance of the loaded cars from one floor to another), as well as the fact that one portion of the factory is separated from the other by a public highway, across which it would be impracticable to string the trolley wire, placed that system out of serious consideration. The ability of storage batteries to accomplish the required results was for a long time questioned, and several engineering firms to whom Norton Bros. submitted the plan refused to make the experiment, for the question of economy of space in the construction of the locomotive was, in a certain sense, restrictive. The matter was finally taken under consideration, however, by the firm of Pierce & Richardson, Chicago, which drew the specifications and completed the arrangements for the installation.

The locomotive itself is 5 feet long, 30 inches wide, and 44 inches high, and weighs complete, approximately, 5,000 pounds. It has four 20 inch wheels, and is provided with a toggle brake. As seen by the illustration, it is built of wood, and while it is somewhat crude in appearance, it is constructed in a very substantial manner. Entirely enclosed and occupying the upper portion of the locomotive is the battery space, 12 inches high, in which is contained 24 type E 15 chloride cells of 350 ampere hours' capacity. Naturally the traction conditions are worse than upon an ordinary street railway system, yet, notwithstanding the jarring and bumping, the cells thus far have given excellent satisfaction.

A series wound General Electric N. W. P. motor, rated for 6 horse power at 80 volts is geared by single, reduction gearing to one of the axles, but in this case it is operated at 50 volts and furnishes about 4 horse power. The whole is mounted upon a McGuire truck. The locomotive, as built, was designed to pull or push approximately 4 tons at a rate of 250 feet per minute. On a test made recently, however, under unfavorable track conditions, it pulled 5 cars weighing in the total 8,328 pounds, the motor at the time taking 2,338 watts. In ordinary practice each of the small cars shown in the illustration, when loaded with tin plate, weighs on an average 1,650 pounds. Unloaded each car weighs about 400 pounds.

The batteries are at present charged from a Crocker-Wheeler generator of 40 horse power capacity. This generator also furnishes power at 220 volts for several motors operating machinery in different parts of the factory, including one of 15 horse power, one of 20 horse power and two of 10 horse power. There is also in the dynamo room a Thomson-Houston dynamo of 60 horse power capacity furnishing current for lighting purposes. These two machines are belt driven by an 80 horse power Ball engine, the steam being furnished by a Babcock & Wilcox boiler fired with crude oil. Edison generators are to be set up in a new dynamo room now building. In charging the batteries the 220 volt current is reduced by the choke coils seen in the illustration to a current strength of 35 amperes at 60 volts. This arrangement, of course, is only a temporary expedient. The permanent charging arrangement is interesting, and will consist of a number of stage plugs and sockets so arranged that a plug can be inserted in but one position, thus maintaining a constant polarity, the plug to be permanently connected to the terminals of the battery through a Carpenter enamel fixed resistance placed under the floor of the locomotive, and carried in a dead socket. Sockets will be placed in a number of convenient points in




STORAGE BATTERY LOCOMOTIVE IN A FACTORY.

the factory buildings, connected to a 110 volt circuit from the factory dynamos, so that whenever the locomotive is standing idle, even for a short time, the motorman can insert the plug in the nearest socket and allow the charging to proceed during the time in which the train is not in service. By this arrangement it is expected that the cells can be kept fully charged without requiring attention outside of factory hours.

The controlling apparatus provided for the locomotive is simple and consists of a series resistance and a special controlling switch with contacts supplied for reversing the armature current and protected, as seen, by a metallic arched covering. The switch handle is of sufficient length to enable the motorman to stand upon small platforms, one at each end of the locomotive, and thus control its action conveniently. So successful and satisfactory has been the introduction of this novel system that a number of additional locomotives are under consideration by Norton Bros. The batteries were installed under the direction of Frederick L. Merrill, Chicago.

## Joel Hurt.

The new president of the American Street Railway association, whose pictured face adorns this page, is well known to the street railway men of the country. He has for several years taken an active and intelligent interest in the affairs of the association, and is one of the best posted men in the South on street railway matters, having compiled interesting and valuable statistics of the industry with which he is connected. Mr. Hurt is president of the Atlanta Consolidated Street Railway company, and as chairman of the local committee of arrangements he is entitled to much of the credit of the success of the Atlanta meeting of the organization which honored him by electing him as its president.

Joel Hurt is a native of Alabama and forty-four years of age. As a boy he was bereft of parental support, and he is indebted to his own exertions for his success in life. By hard work he obtained an education, and in 1871 he was graduated by the University of Georgia with a degree as a civil engineer. For several years he practiced his profession, making surveys, principally for railroad companies. After that he engaged in commercial pursuits in Atlanta, becoming known as an enterprising and progressive citizen. He has been connected with a number of enterprises, including the Atlanta Home Insurance company and the East Atlanta Land company. In 1891 he became president of the Atlanta Consolidated Street Railway company, and he undertook to consolidate all the city lines under one management and to equip them with electricity. Five companies were so consolidated, and the system now embraces nearly sixty-four miles, being one of the best constructed and managed systems in the South. Many obstacles and vexatious difficulties have been overcome, and the system is to-day a monument to the energy and ability of Mr. Hurt. In 1892 and 1893 Mr. Hurt was one of the vice-presidents of the association.

## American Institute of Electrical Engineers.

At the meeting of the council of the Institute held on the 17th instant the following named gentlemen were elected to associate membership: John R. Cole, San Francisco, Cal.; Harold McGill Davis, New York, N. Y.; Franz J. Dommerque, Chicago, Ill.; Thomas Duncan, Fort Wayne, Ind.; Kingsley G. Dunn, San Francisco, Cal.; Chas. Locke Etheridge, Chicago, Ill.; M. K. Eyre, Harrison, N. J.; James S. Ford, Chicago, Ill.; Arthur L. Hadley, Fort Wayne, Ind.; Arthur W. Jones, Port Elizabeth, So. Africa; Chas. L. Keller, Chicago, Ill.; Sherwood J. Larned, Chicago, Ill.; C. Per Lee Noxon, San Francisco, Cal.; J. J. O'Connell, Chicago, Ill.; Camillo Olivetti, Ivrea, Italy; S. Arthur Rhodes, Chicago, Ill.; L. St. D. Roylance, San Francisco, Cal.; Ward M. Sackett, Chicago, Ill.; Edwin N. Sanderson, Boston, Mass.; Frederick R. Slater, New York, N.Y.; Herman A. Strauss, Newark, N. J.

At the Institute meeting in the evening a paper was presented by Lieut. Samuel Reber of Fort Riley, Kansas, late of Johns Hopkins University, on the "Theory of Two and Three-phase Motors." The paper was read by title by the secretary, and the discussion opened by Dr. M. I. Pupin. A paper was also presented by Charles P. Steinmetz of Schenectady, N. Y., on the "Theory of the Synchronous Motor." Both papers were discussed by Messrs. Kennelly, Pupin and Steinmetz. Seventy members and visitors were present.

# THE CONVENTION

## Of the American Street Railway Association at Atlanta, Ga.

Members of the American Street Railway association from all parts of the country gathered at Atlanta, Ga., on October 17th to participate in the thirteenth meeting of that organization and accept the hospitality and entertainment so generously extended by the southern members, especially the local street railway magnates. The sessions of the convention were held in Machinery Hall, Piedmont Park, and the exhibit of street railway apparatus was in the same building. On Wednesday morning President Henry C. Payne of Milwaukee called the members to order at the first session of the convention and introduced Hon. W. J. Northen, governor of the state, who made an address of welcome, in which he said:

We are delighted to have you here, because we want you to learn what are the productions and resources of this section; and I am sure that after having looked upon the developments now being made upon these grounds, and realizing the prospect that awaits us in the development of our exposition, you will not only return to Atlanta to visit our exposition, but that you will bring your industries and settle in Georgia and help us develop the great interests of this great state.

We want you to know that the financial conditions of Georgia and the South have been equal to, if not better than, any other sections in this great country of ours. In the last financial stress that came upon the people of this country there were fewer bank failures and business failures at the South than in any other section. The records show that the people of the South owe less money than any other section. Land mortgages for fourteen southern states amount to $33,000,000 for each state, on an average, while the average for fourteen northern states is $344,000,000. The average annual interest paid by the fourteen southern states upon mortgages is $2,600,000; for the fourteen northern states it is $21,900,000. The average per capita of mortgage indebtedness for the fourteen Southern states is $25; the fourteen northern states is $129.

JOEL HURT.

We are glad to welcome you because you are business men, who consider questions of interest from the standpoint of men who have large interests at stake and who have capital to invest, and we invite you to Georgia for their investment. Why not make street car wheels out of pig iron at the South, manufactured at the South? Why not make street railway rails out of pig iron at the South, manufactured at the South? Why not remove your industries from more expensive sections down to this section, where you buy cheaper raw material, where you have better advantages of manufacturing and your business interests can be better developed?

You have developed your own business in the South to a very great extent. We have 1,611 miles of street railways in the South. You have put in for the southern states, and the Southern states have helped you put it there, and invested capital in this industry amounting to $71,080,000, and all that has been done at the South within the last six years. We welcome you again because you represent the greatest factor in civilization known to the northern world. You have enhanced the value of this great country of ours more than any other half dozen factors for producing wealth that have been in operation for the last quarter of a century. You broaden out cities; you scatter the density of population; you make it convenient for the professional man, for the business man and for the laboring man to go from his home to his work with the least expenditure of time.

President Payne fittingly acknowledged Gov. Northen's welcome, on behalf of the association, and delivered his annual address which is appended:

For your partiality in electing me to the office of president of the association I desire to return my most heartfelt thanks.

It is hardly necessary for me to say that since our last meeting the street railway business has suffered, in common with all other enterprises, owing to the financial stringency and business depression which have prevailed in all parts of the country. These conditions, however, have not been without lasting benefit to the interests which we represent. I think we have all studied more thoroughly to bring about economies in operation, to limit construction of new lines into unproductive territory, and in every way to bring our business to a more healthy basis; so that, from that point of view, there is compensation for the depression through which we have passed.

I presume it is the common experience of all that we are on the up grade, and I confidently anticipate a slow but gradual return to normal business conditions. The resources and characteristics of the American people are such that they cannot long continue in a state of either mental or financial depression.

During the transition period from animal to electric power on the tramways of our country it was but natural that the proceedings of the annual meetings of the association should be largely taken up with the consideration of the application of electricity to transportation purposes. Now that we may fairly consider such application as an accomplished fact, I think our attention should to a greater degree be turned to a comparison of views regarding the practical operation of our several roads.

The substitution of electricity for animal power has elevated the business to a higher plane. Street railways have become as essential to the prosperity of our metropolitan cities as the steam railways to the country at large.

Having had practical experience in the management of both these methods of transportation, I can fairly say that the duties of the manager of a street railway equipped for rapid transit are more vexatious than, and require quite as much ability, intelligence and application as, those of one in charge of a steam railway. The steam railway manager makes his timetables, publishes them, and the people are expected to, and do, suit their convenience to the same. Not so with us. We are expected to make our timetables conform to the convenience of each individual separate passenger who desires to be transported, and a car is expected to be at each and every corner at the identical moment when the passenger is ready to be carried.

Again, the steam railway manager has to encounter legislatures and legislation but once in two years, or at the most once in each year, and that during a short period in the winter only; while the life of the street railway manager is made unhappy, to say the least, by the legislative bodies in cities, which are practically in continuous session.

The American capitalist is quick to discover promising fields for the investment of capital, and I think it is safe to say that never in the history of our country has there been a more rapid development than has come from the application of electricity to transportation purposes. In the anxiety to secure franchises and to reconstruct street railways, very excessive valuations have been placed upon and paid for the right to operate by electricity in our large cities. This has led the representatives of the people to believe that there is a present value attached to franchises far beyond that which the facts will sustain.

Consequently these conditions have led to a fruitful field for the legislator as well as for the assessor, from whose tender solicitude for the welfare of the people the street railways, whose prosperity contributes so much to the general good, have suffered.

The interest as well as the inclination of most managers tends toward giving as liberal and good service to the public as the patronage will justify.

Transfers and to what extent they should be granted, commutation and its effects upon earnings, and the relative earnings of cars operated on long and short time headway, furnish fruitful topics for discussion and comparison of views. These and many other practical subjects which will occur to you, I think should receive your attention, and I believe their consideration will be not only of great interest but of material advantage to us all.

Your executive committee has set apart one morning for executive session, at which time I trust we shall have full and free exchange of views bearing upon matters to which I have referred and many others affecting the practical operation of our roads.

The question of insurance has become a perplexing one. In many instances the larger systems find it very difficult to obtain insurance in sufficient amounts to cover their risks, and I think the common experience is that rates have increased to such an extent as to be so burdensome as to justify us in considering the propriety of organizing a mutual insurance association.

I cannot close without referring to the great loss which we have suffered from the removal by death since our last meeting of two of our most prominent and active members.

William Richardson of Brooklyn, N. Y., had been identified with the association since its organization. All will recall the great interest which he took in our deliberations, and I am sure that we all feel a sense of personal sorrow that we shall no more have his wise counsel. His life's work, so far as business activities were concerned, was completed, and he was looking forward to that quiet and

peaceful ending of his days to which a long and active life had entitled him.

William J. Stephenson of Washington, D. C., first vice-president of the association, was to my mind an almost perfect type of an aggressive, forcible, intelligent business man. He had been for a considerable time engaged in maturing plans for the introduction of the underground trolley system upon his road. To this end he had succeeded in obtaining the necessary legislation from Congress, and his plans were very far matured toward the actual commencement of the work of reconstruction. We cannot but regret that he has not lived to consummate the plans which he had so ably matured. Mr. Stephenson was looking forward with the greatest interest to this meeting, and I am sure that I but reflect the sentiment of every member in expressing my sorrow and regret at his ultimately taking off.

Letters of regret were received from Charles B. Holmes and Henry M. Watson, ex-presidents of the association, who were unable to attend the meeting.

The report of the executive committee showed that a number of changes had been made in the membership, numerous additions and some withdrawals being recorded. Valuable assistance from the technical press was acknowledged, and the following tribute to the memory of departed members was adopted:

OBITUARY.

William Richardson departed this life December 31, 1893, in the seventy-first year of his age. He was for many years the president of the Atlantic Avenue Railroad company of Brooklyn, from which position he retired the early part of last year. He began his street railway experience with the Dry Dock, East Broadway & Battery Railroad company of New York, and was acting president of that company at the time of his death. He was a regular attendant at the annual meetings of this association, and always took a lively interest in its welfare. He was an ideal companion in his home, of the strictest integrity in business, of untiring energy and high ambition to excel in all he undertook to do, and withal a sincere friend. We shall miss his inspiring presence.

John H. Dalzell died May 29, 1894. He was the president of the Pittsburgh, Allegheny & Manchester Traction company, and a man of large influence in the community in which he lived. He was blessed with exceptional foresight, and he succeeded by his indomitable pluck, energy and earnest purpose in attaining a position of large prominence.

Allen Tindolph died July 27, 1894, aged fifty two years. He was the president of the Vincennes Street Railway company, and was prominent in other business enterprises in the place where he lived. He was a man who stood very high in the esteem of his fellow citizens by reason of his sterling qualities of character. He was a Christian gentleman and a public spirited citizen.

For the first time in the history of the association an officer has died during his incumbency. William J. Stephenson left the sphere of his earthly activities on August 31, 1894. He was the president of the Metropolitan Railroad company of Washington, having been previously connected with the Columbia Railway company of the same city in a like capacity. He was energetic, enterprising; in short, a typical progressive American. Always enjoying the best of health, with ruddy, clear complexion, of commanding appearance, having convictions and the courage of them, a ready speaker, always with something to say, re-enforced with deep interest in this association, his was a familiar figure and voice at the annual meetings. We shall sadly miss our friends and companions.

The report of the treasurer showed the receipts of the year to have been $8,290.79; expenses, $8,196.72; leaving a balance of $94.07.

A communication from the Georgia Electric Light company was read, extending an invitation to the delegates to visit the plant.

The first committee report presented was on "The Best Method of Treating Accidents and Complaints," and was read by P. M. Dyer, claim agent of the West Chicago Street Railroad company.

After an extended discussion of this subject, a report was received from the committee on "A Uniform System of Street Railway Accounts," which received considerable attention.

Before adjournment the secretary announced that the members of the convention would inspect the exhibits immediately after the meeting; that at four o'clock a visit would be made to the car house of the Atlantic Consolidated Street Railway company, and that from six until nine o'clock a reception would be tendered to the delegates and ladies accompanying at the Capital City club.

## Thursday's Session.

An executive session was held on Thursday morning by order of the executive committee. At this meeting the subject of "Transfers and Commutations" was considered, the general impression being that the privileges should not be extended further than is absolutely necessary. The proposed formation of a street railway mutual fire insurance company was discussed, and on motion of Russell P. Harrison the incoming officers and executive committee were appointed a committee to report on the subject. Messrs. Littell, Perrine and Connette were appointed a committee to wait upon the officers of the Underwriters' Association of the South, with a view to securing better conditions and rates for insurance of street railway properties. The executive session was then adjourned.

At the regular session which followed, the paper, "Can the T Rail be Satisfactorily Used in Paved Streets?" was read.

The following named gentlemen were appointed a committee to nominate officers and select a place for the next meeting: Messrs. McLean, Connette, McNamara, Baumhoff, Breeg, Semmes and Rugg.

Letters of invitation inviting the association to holds its meeting in their respective cities were presented in behalf of Cincinnati, O., Philadelphia, Pa.; and the invitation extended at the Milwaukee meeting by Mr. Lusher of Montreal, for the association to hold its meeting in that city for 1895, was read by the secretary.

## Friday's Session.

President Payne called the meeting to order at 10:30 A. M. The first business was the report of the committee on "City and Suburban Electric Railways," which was ordered printed in the proceedings.

The report on "The T Rail Construction of the Terre Haute Street Railway Company" was also read.

Telegrams were read from Thomas Lowry, president of the Twin City Railway company, Minneapolis, and also from the Commercial clubs of Minneapolis and St. Paul, inviting the association to hold its next meeting in the great convention city of the Northwest—Minneapolis.

A letter from O. T. Crosby was read, regretting his inability, owing to pressure of business, to present a report on

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"Standards for Electric street Railways." On motion of Mr. Perrine, the committee on standards was continued.

M. K. Bowen, superintendent of the Chicago City Railway company, suggested that a committee be appointed to investigate the subject of the validity of patented articles used by street railways.

The matter of the proposed amendments to the constitution and by-laws, to provide for associate members, was then considered. An informal vote was taken as to the adoption of the amendments, and it was the unanimous judgment of the members that the amendments should be adopted. Final action will be taken at the next annual meeting.

The special committee appointed to interview the representative of the Underwriters' Association of the South reported that it had been unsuccessful in its efforts.

Mr. Brophy of Boston, representing the Mutual Insurance Association of New England, said:

I think it would be better for each state association of railways to make application to the board of underwriters of the mutual companies which control its territory. I think something might be done in that way to secure a reduction. Our company is not a stock company. We have no agents and pay no premiums, so that we can afford to carry the business at somewhat lower rates. Ours is the only company at the present time which is carrying electric light and railway properties. We have been insuring electric light stations and power houses for two years and car houses for one year. We have at the present time seven million dollars of property of this class, and for the last ten or twelve months, ending October, our losses have been twenty-three hundred dollars on the seven millions. We have been able to pay a dividend of seventy per cent. on business written one year ago. We have been insuring this character of property for two years. I make this statement in order to show you that the electrical business is not so hazardous as some people think it is. It can be insured at a profit. We have paid some losses; at the same time we have paid to our policyholders forty per cent. of the premiums paid. The premiums collected have paid losses and expenses, and left a balance to be returned to the policyholders, so that the business is not so very bad. Our rates on electric light stations are one per cent., which calls for a station which is a model in every way. We do not ask for cement floors or iron floors, nor do we ask that the roof shall be eighteen feet high; but we want a plant that is clean and has no oil on the floors; no finish on the walls, and no attics and no basements. If it has a basement or second floor used for storage, it must be equipped with automatic sprinklers. Our experience with car houses has been so far very fair. We do not know just what the losses will be, but our premiums so far have met all expenses. Our expenses for inspectors have amounted to six per cent. of premiums received, and the total expense, including losses, is twelve per cent.

The president appointed the following special committee on the subject: Messrs. Harrison, Terre Haute; Dyer, Augusta; Perrine, Trenton; Lusher, Montreal; Baumhoff, St. Louis.

Mr. Perrine offered the following:

*Resolved*, That the executive committee is hereby requested to take under consideration the question of the enlargement of the field and scope of the association, and submit a plan suggesting ways and means therefor at the next meeting of the association.

The nominating committee presented the following report:

President—Joel Hurt, Atlanta, Ga.

First vice-president—W. Worth Bean, St. Joseph, Mich.

Second vice-president—John M. Cunningham, Boston, Mass.

Third vice-president—Russell B. Harrison, Terre Haute, Ind.

Secretary and treasurer—William J. Richardson, Brooklyn, N. Y.

Executive committee—Henry C. Payne, Milwaukee, Wis.; W. H. Jackson, Nashville, Tenn.; D. G. Hamilton, St. Louis, Mo.; G. C. Cunningham, Montreal, Canada; J. N. Partridge, Brooklyn, N. Y.

The committee recommended Montreal, Canada, for the next meeting. The entire report was adopted, not, however, until after a spirited discussion over the next place of meeting.

The report of the committee on "Mail, Express and Freight Service on Street Railway Cars" was then read by title and was ordered to be printed in the proceedings.

The report of the committee on "Transfers and Commutation" was read by title and ordered printed.

The report of the committee on "The Use of the Booster on Electric Railway Circuits," after a few remarks giving the substance of the report, was ordered to be printed in the proceedings.

Messrs. Dunlop of Washington and McNamara of Albany were appointed a committee to escort the newly elected president to the chair. Mr. Payne introduced Mr. Hurt, who said:

I thank you sincerely for this honor. I have not sought

it, but I appreciate it none the less. I am fully in accord with those who have the interests of this association at heart. I can do no more than ask your co-operation, free consultation and help in every direction. The executive committee, of course, will have certain important matters before it, but with your secretary must lie the main weight, and I have no doubt that he will discharge his full duty. I feel that this association is entering upon an era of much more useful work than has already marked its career. Its scope should be enlarged. There are many features of the work devolving upon the managers of street railways in which they need help from this association, and this question should have your special attention during the next twelve months.

On motion of Mr. Perrine a vote of thanks was extended to the retiring officers, the Atlanta Consolidated Street Railway company, the Capital City club, the local press and the people generally of the city of Atlanta for the courtesies, kindness and attention and generous hospitality which had been extended to the association.

The report on "Destructive Arcing of Five Hundred Volt Fuses" was read by title only and ordered printed in the proceedings.

The paper on "Brake Shoes" was also read by title and ordered printed in the proceedings.

In accordance with the recommendation of the author of the paper, a committee was appointed consisting of two members of the association and one manufacturer to investigate the subject of the adoption of a standard style of brake shoes, conduct experiments, and to report the data collected and its conclusions at the next meeting without expense to the association.

The report on "Power Brakes vs. Hand Brakes," by E. J. Wessels, was read by title only. It was ordered to be printed in the proceedings.

## Reception at the Capitol City Club.

On Wednesday evening a reception was tendered the members of the convention by the Capitol City club, which was participated in by a large number of the visitors. The reception was said to be one of the best ever given by the club, and every one remarked upon the beauty and cordiality of the entertainment. The dancing hall of the club was handsomely decorated, and the fine floor and excellence of the music combined to further the pleasure of those who participated in the dances. A speech of welcome was made by Major Livingston Mims, president of the club, which was exceedingly happy and to the point. Refreshments were served throughout the evening, and every one expressed delight with the entertainment.

## The Banquet.

The annual banquet was held at the Kimball House on Thursday evening, October 18th. It was very largely attended and was most admirably served in every particular. The banquet commenced at 9 o'clock, the exercises being opened by singing a verse of a national hymn. During the discussion of the menu excellent music was furnished by the orchestra. The speeches began at 11.30 P. M. President H. M. Payne introduced Mr. Stedman, who responded by a number of humorous anecdotes, which were most enthusiastically received. Some lines well fitted to the occasion which Mr. Stedman repeated were heartily applauded. Mr. Payne then introduced in turn the speakers of the evening. Hon. H. E. W. Palmer responded to the toast "At'anta" in a most happy vein. C. D. Wyman responded to "Our Association," and commented pleasantly upon the social pleasures which were tendered the delegates by the citizens of Atlanta. Lewis Perrine next made a suitable response to "The Street Car a Factor in Modern Civilization." The next toast was responded to by Capt. Harry Jackson, "The Railroads and the Law." "The New South" was responded to by Hon. L. C. Levy. The toast "The Technical Press" was well taken care of J. H. McGraw. Lucien Knight responded to "The Local Press." Fleming du Bignon, Savannah, responded in eloquent manner to "Our Common Country." The toastmaster then offered a toast to the future president of the association, Joel Hurt. After repeated applause, Mr. Hurt responded and thanked the members of the association for the honor bestowed upon him. Three cheers were then offered for Atlanta and the New South, after which the banquet adjourned.

## The Barbecue.

A barbecue was held Friday afternoon at Ponce De Leon Springs, one of the city resorts. It was quite a novel form of entertainment for many of the visitors, but they thoroughly enjoyed their feast in the woods, and every one was delighted with the experience.

## Exhibits.

F. H. Stanwood, Chicago, had a number of his Stanwood steel car steps on some of the exhibition cars, and they attracted much attention.

The H. Falk Manufacturing company, Milwaukee, exhibited the Falk trolley; also a section of the Hoffman cast-welded continuous rails for street railways. The company was represented by A. Hoffman.

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The Ohio Brass company, Mansfield, O., showed a handsome sample board and a complete line of overhead material. C. K. King was in charge. An exceptionally tasteful souvenir was distributed by the company. It consisted of a booklet illustrating the various types of overhead material and specialities made by this company, which appeared for its first convention representation at Atlanta.

Arthur S. Partridge of St. Louis distributed souvenir pencils calling attention to the full line of electric street railway appliances which he handles.

The J. G. Brill company, Philadelphia, exhibited several styles of its trucks, and also had some very beautifully equipped cars running on the city lines.

C. L. Cornell, Hamilton, O., made a display of arc headlights for street cars and electric soldering irons for electric railway repair shops. He was assisted by J. J. Bettinger.

The New York Electrical Works of New York had a full line of standard overhead material on hand, comprising circuit breakers, cross-overs, switches, insulation and mechanical clips. C. W. Van Fleet was in charge.

The Partridge Carbon company of Sandusky, O., was represented by James Partridge, who showed samples of his well-known self-lubricating motor brushes. This company received many compliments for the good wearing qualities of its goods.

The Fuel Economizer company, Mattewan, N. Y., showed a number of specimen castings of the Green fuel economizers, together with drawings and pictures. The company's exhibit and interests were looked after by B. Pearson.

Smith of New York made a display of combination center lamps for cars and electric cluster lights, with silver glass reflectors. A number of incandescent lamp shades, silvered on glass, were exhibited. Thomas C. Miller was in charge.

The Georgia Equipment company, Atlanta, made a display of the new Beacon lamps, Empire electric insulation, Allen line material, and the Hubley and Medbery insulations. J. T. Voss and Woodford A. Brooks represented the company.

The Jewell Belting company of Hartford, Conn., made a handsome display of belting, among other things showing a section of a 69 inch 3-ply Jewell railway dynamo belt. It also showed belt cords for street railway cars, Jewell dynamo belt cement and dressing.

The Standard Railway Supply company, represented by its president, Garson Myers, showed its standard car stoves, so constructed as to prevent cutting of the car seats, also gilt edged steel gongs, track scrapers, adjustable track brush holders and line materials.

The General Agency company of New York showed the Dragon headlight and electric and oil signal lights. A special danger signal lamp and route signal lamp for electric and cable cars was a prominent feature of the exhibit. Joseph R. Ellicott, president, was in attendance.

The Cutter Electrical Manufacturing company of Philadelphia, Pa., showed the C S automatic magnetic cut-out, which protects armatures and motors from grounds, short-circuits, etc., without bringing cars to a standstill. Charles Bibber and W. E. Harrington were in attendance.

The Meaker Manufacturing company of Chicago exhibited its new register; also a new mechanical clip, consisting of two pieces only and a new trolley hanger with taper bolt, which it claims is truly adjustable. J. W. Meaker, president, was on hand to explain the merits of the company's goods.

The Charles Munson Belting company of Chicago showed different kinds of dynamo and Eagle belting, up to 48-inch belt. The exhibit of A. Groetzinger & Sons, Pittsburg, was combined with this display, and comprised the well-known rawhide pinions. H. E. Skinner was in charge.

Charles A. Schieren & Co. of New York was presenting delegates a very pretty souvenir note book, showing the tannery at Bristol, Tenn., and calling attention to the well-known brands of oakbark tanned leather belting. One of their principal specialties is perforated electric belts for street railways.

The Rochester Car Wheel Works of Rochester, N. Y., showed a number of car wheels with bar contracting chill. An interesting wheel among these, was one having a record of two years' service and 70,000 miles run. F. D. Russell, general manager, and George C. Morse, general sales agent, were in attendance.

Wadhams Oil & Grease company of Milwaukee showed samples of curve grease, motor lubricants, oil compression cups, floor soap stock and lubricating devices. This company makes a specialty of lubricants for street railways. E. A. Wadhams, president, and George A. Streator were present to explain the merits of their goods.

Creaghead Engineering company made a special display of its new flexible bracket. It also showed a number of samples of overhead line electric appliances, comprising pull-over brackets, straight line insulators, trolley switches, rail bonds, trolley splices and trolley wheels. R. Scrughan was looking after the interests of this company.

Benedict & Burnham Manufacturing company, Waterbury, Conn., showed new rail bonds, made solid and in one piece, for which it claimed more contact surface than any other bond. It also showed a number of fine samples of feed, trolley and magnet wire. The representatives of the company were E. H. Oswald and J. H. Woodward.

The Fulton Truck & Foundry company, Cleveland and Mansfield, O., made a large exhibit of motor trucks. W. E. Haycox, president and general manager, and Frank A. Rodgers, special sales agent, were present to explain the merits of their trucks. A hydraulic motor lift and improved track cleaner were special features of the exhibit.

The following represented the General Electric company at the convention: W. J. Clark, general manager railway department; T. P. Bailey, H. G. Crowley, J. R. Lovejoy, A. K. Baylor, H. C. Wirt, Joseph Hoffman, W. B. Potter, G. F. Rosenthal, F. W. Kimball, S. W. Trawick, A. F. Giles and Messrs. Bulleo, Thompson and Wilcox.

The Wallace Electric company of Chicago exhibited samples of the Robinson patent trolley wheel, Fletcher's rapid transit switch and the Paulsen rail bond cap. It also distributed a very neat souvenir pamphlet, illustrating its line of of railway specialties for overhead construction. The interests of the company were looked after by Max A. Berg, secretary.

The Stilwell-Bierce & Smith-Vaile company of Dayton, O., made a large display of Stilwell heaters, Smith-Vaile pumps, Victor turbine water wheels, railroad track jacks and Worrall patent friction clutches. It also exhibited a Smith-Vaile air pump and condenser of 1,000 horse power capacity. J. W. Taylor, southern agent, was in charge of the exhibit.

The Central Electric Heating company of New York made a handsome display of their American electric heaters, showing three different styles for car heating, all in operation. It has heaters on some 200 roads, and this make is also used on the North Side lines in Chicago. The company was represented by E. B. Wyman, general manager, R. S. Jerome and Sidney Hoch.

The Sperry Electric Railway company, Cleveland, had one of its cars running on the city lines at the exposition building, showing the practical operation of the Sperry single motor flexibly connected to both axles, and the action of the new Sperry electric brake. This car attracted much notice, and many delegates took occasion to run the car and test the brake. Elmer A. Sperry was on hand to explain the system.

The Berlin Iron Bridge company of Berlin, Conn., had a booth constructed in the form of a miniature car station, such as it constructs for electric railways. One feature of these station buildings is the protection of the plant from condensation. They do this by special interior roofing of Neponsett building paper and asbestos. J. M. Field, as-

sistant engineer, and J. C. Murphy, erector, were in attendance at the convention.

Paige Iron Works of Chicago exhibited special work in both girder and T rails; also special street and steam railway crossings. This company manufactures and makes a specialty of all kinds of track work for electric and cable railways. It sends its own engineers to take angles and make all necessary measurements, and guarantees its work to be accurate and satisfactory. Alonzo W. Paige, president, and E. S. Nethercut, engineer, represented the company.

The Michigan Electric company, Detroit, made a neat display, comprising a complete line of overhead material, including different styles of hangers, switches, cross-overs, pull-offs, etc. A particular feature of this exhibit was the trolley wire clamp; also a signal light for electric cars, consisting of a lantern containing an incandescent light with semaphore lens, which attracted much attention. Joseph E. Lockwood, president of the company, was in attendance.

The Western Telephone Construction company of Chicago had a 50 drop switchboard, with switchboard transmitter, head-phone, generator, and night alarm. This was connected up with telephones distributed throughout the hall, so as to show a complete telephone plant of their system in practical operation. They also showed magneto-telephones, portable desk telephones and swinging arm desk 'phones. George F. Stith, vice-president, represented the company.

The Consolidated Car Heating company of Albany, N. Y., had two car seats on exhibition equipped with different styles of standard and riser electric heaters. It also showed a number of short heaters made for cars with cross seats; in conjunction with these was a full line of controlling switches for both temperature and current, snap switches and cut-outs. The company was represented by J. F. McElroy, consulting engineer, E. A. Smith, general western agent, and H. R. Ransom, general eastern agent.

The *Street Railway Journal* received many compliments on its elaborate and handsome souvenir number, and it deserved them all. The issue commemorated the tenth anniversary of the *Journal* as well as the Atlanta meeting. It contained a 16 page article on Atlanta, a 10 page article on the association, 30 pages on the street railway systems of the southern cities, and 20 pages on the history of the street railway industry. All of these were finely illustrated, containing over 400 pictures, among which were more than 125 portraits of street railway men.

Card Electric company of Mansfield, O., was represented by Read Carpenter, president; George S. Card, electrician, and John F. Card, superintendent. It had an exhibit showing 35 horse power single motor equipments and also a 70 horse power double motor equipment for interurban services. The company also showed its series multiple controller for both single and double equipments, and a new pneumatic quick-throw switch for heavy currents. The motors are equipped with a special device for turning off the commutator without removing the armature from the field, which attracted much attention.

The Mason Electric company, Chicago, occupied parlor 24, Aragon Hotel, and it was its intention to exhibit a full line of the Medbery overhead material. A very handsome line of these popular goods was shipped from the factory but failed to reach Atlanta in time. The Medbery material, having been adopted by such a large majority of the leading traction companies, naturally attracts a great deal of attention, and regrets were numerous on the part of street railway managers at the delay which prevented the company from making its usual display. Mr. Mason kept open house, and visitors were constantly in attendance.

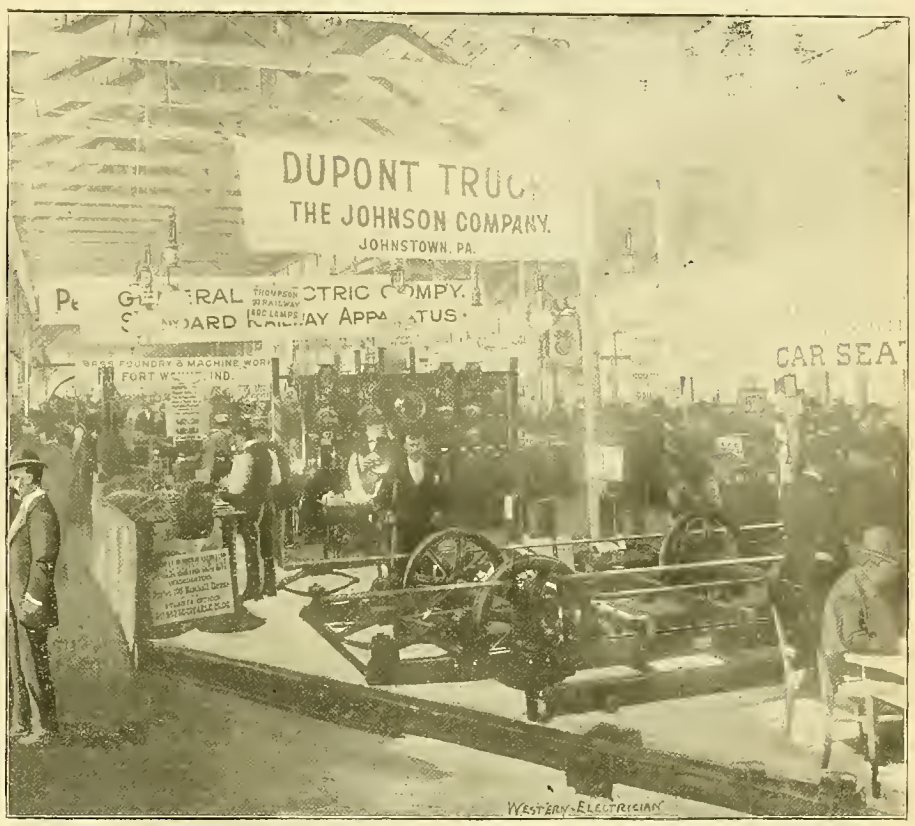
R. D. Nuttall company, Allegheny, Pa., made a very complete exhibit of gears for all standard types of motors, particularly those of the Westinghouse and Walker types. In addition to this a full line of overhead railway material was included in the exhibit. The company makes a specialty of trolley harps and wheels, and the Acme malleable harp, with Nuttall wheels, are widely used both East and West. It also exhibited an improved Nuttall trolley base, in position as in regular operation, which it claims is so adjusted as to pull a uniform weight at all angles. F. A. Estepp, president, and Garson Myers represented the company.

The Walker Manufacturing company of Cleveland made a handsome exhibit, comprising a 200 horse power generator, a Dorner & Dutton truck, equipped with two 30 horse power motors and controlling stands, together with a complete car equipment, both generators and motors being shown in operation. A single 30 horse power motor, open, so as to show the construction and effect of spring mounting on rail joints, was another feature of this company's exhibit. The company was represented by W. H. Bone, general manager, Prof. S. H. Short, J. Atkinson, B. M. Barr, H. McL. Harding, G. A. E. Kohler and Frank Kohler. The exhibit was in charge of R. M. Bayliss.

The Westinghouse Electric & Manufacturing company, Pittsburg, showed samples of all kinds of street railway appliances, particularly Wurts lighting arresters. The principal part of its exhibit consisted of the new plant which it has just installed for the Consolidated Street Railway company of Atlanta, which consists of one 750 horse power direct connected generator and two 400 horse power belt connected generators. It also showed two motors on a Peckham truck and a number of other motors on exhibition cars. The company was represented by W. C. Clark, general agent; W. F. Zimmerman, assistant general manager; A. J. Wurts, electrical engineer; W. J. Longmore, purchasing agent; Guido Panteleoni; E. H. Heinrichs, advertising agent; J. Rutherford, R. S. Brown, C. A. Bragg, B. F. Stewart, D. A. Thomkins and Fred Gordan.

The General Electric company of New York made a large exhibit. The well-known G. E. 800 motors were shown connected to the line and operated by a form "K" controller, thus showing the action of the latter. The company also showed a number of minor parts of street railway equipments; devices for handling electric arcs, such as switches, fuses, lightning arresters involving the magnetic blow-out principle; also, a modified form of trolley base, with inverted cam and a very fine panel switchboard for power station use, completly equipped with switches, instruments, etc. Samples of underground feeder tubing and models of junction boxes and caps were displayed. Ten Thomson '93 arc lamps, designed for use in car houses, power houses, or wherever it is desired to light from the 500 volts circuit, were also exhibited. A portable Thomson recording wattmeter, for testing purposes, was among the material exhibited.

The H. W. Johns Manufacturing company had an exceptionally neat exhibit, which attracted a great deal of attention. It was in a conspicuous location near the center of the building. Samples of trolley line insulating materials, vulcabeston for both steam and electrical purposes, and asbestos pipe covering, tastefully arranged, made a handsome display. Special attention was called to the very complete line of moulded mica overhead materials, including switches and the "H. W. J.," Perry and Philadelphia mechanical clips. It was noticeable that the devices were evidently adapted for substantial construction, judging from their strength and durable qualities. The samples of vulcabeston were principally parts which the company has furnished for the various controllers in the market, their well-known magnet spools for motors and dynamos, and brushholder bushings. Various sizes and styles were shown of vulcabeston for steam, hot water and other purposes. The company this year added to its exhibit asbestos pipe coverings, which are already familiar to station managers. There were also samples of asbestos rope, cord and clothing. The company issued for the occasion a revised edition of its former "Insulation" list, changing its name to "Insulating Materials." This list is very complete, and several reductions have been made in former prices. There was an interesting model of the Granten rail bond, showing the facility with which the bonds and return wires can be connected to the rail. W. F. D. Crane of the company's electrical department of New York was in charge. There were also present W. H. Gould of New York, now a resident in Atlanta, and Henry G. Issertel, salesman, New York. J. W. Perry from the company's Philadelphia office; E. B. Hatch, secretary of the Johns Pratt company, Hartford, and H. Luscomb, also of the Johns Pratt company, made their headquarters at the exhibit of H. W. Johns Manufacturing company.

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## Farmers Want Telephones.

A newspaper dispatch from Pine River, Wis., gives the following information: The farmers in this section of Waushara county are up in arms against the Wisconsin Telephone company, and are patrolling the line from Poysippi to Justin day and night to prevent the employes of the telephone company from cutting down the poles on the line. This line was abandoned on August 1st. Dr. H. A. McWain and John Boyson wanted to put in a new telephone line over the poles, but the telephone company would not lease or sell them the poles. This angered the farmers throughout the entire section, as they had purchased and set in place these poles for the telephone company. The company sent out a crew from Milwaukee to remove the poles. Farmers came on the chopping crew and drove them off. The chopping crew was so badly frightened that they ran to the woods and scattered in all directions. It was with difficulty that the men were found and told that the farmers did not intend to lynch them. The crew was gathered together in Berlin again and another unsuccessful attempt made to chop the poles. After driving them off the second time the farmers organized a patrol and are now guarding the property night and day. They are determined to have telephone connection with different parts of the country, and have organized a company to build a line from Berlin to Wautoma via Pig River. Should further attempts be made to remove the poles serious trouble will ensue.

## Legal Rights of the Purchaser of an Electric Plant.

Ordinarily, one who buys property has a right implicitly to rely upon representations of the seller, and if they were false and made with intent to deceive the purchaser, the seller will not be allowed to urge that the buyer, by investigation, could have discovered their falsity. In an action to recover the unpaid portion of the purchase price of a gas and electric light plant sold by one company to another, the latter set up, as a counter-claim, damages sustained by it because of the deceit of the company selling in making the sale. The alleged false representations related to the physical condition of the plant, its wires, poles, gas mains and fixtures, and also the amount of its earnings the year previous to the sale and the prices charged customers for gas and electric light. Under such circumstances the Supreme Court of North Dakota holds, in the case of the Fargo Gas & Coke company against the Fargo Gas & Electric company (59 Northwestern Reporter, 1066), that the company purchasing was under no obligations to investigate the truth of such representations, and that, therefore, it was error for the trial court to charge the jury that, if the means were at its hands to discover the truth or untruth of the statements with respect to these matters, it must be presumed to have had knowledge of the actual facts, the only means at its hands to discover the truth or falsity of the statements made being an investigation of such matters. And it holds that in such actions for damages because of deceit in the sale of property, the measure of damages is the difference between what the property would have been worth if as represented and what it actually was worth at the time of sale.

## A Quick Recovery.

The Siemens & Halske Electric company's factory was destroyed by the great lumber fire in Chicago on August 1st. The company made a lease with the Grant Locomotive Works on August 11th and commenced moving into the new works on August 15th. It finished and shipped the first generator, built entirely at the new factory, on October 15th. Every available tool in the new works is now in operation, and many of the tools which were destroyed in the fire have been duplicated, so that from now on the company is in the position to finish one direct-coupled generator each day. These facts indicate the spirit of the company, which is certainly to-day in a better condition for competition in the electrical field than before the fire.

Western Electrician.

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## HIGH WATER MARK

CIRCULATION, 16,630.

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WE are in perfect accord with an esteemed eastern electrical contemporary in its *exposé* of a ridiculous article in a New York daily by a sensational female writer, who claims to have made a personal test of the efficacy of a trolley car fender. But isn't the expression "frothings from her badly twisted quill" just a trifle confusing?

STREET railway managers are confronted with the question of securing insurance on their plants at reasonable figures. It is the same problem that has disturbed the electric lighting companies for many years, and occupied so much attention at the conventions of the National Electric Light association and the meetings of state organizations. At the Atlanta meeting the question was brought up by the retiring president in his opening address, and it was afterward discussed in the convention. A committee representing the association conferred with representatives of the insurance companies during the meeting, but could not gain any concession. Captain Brophy, who was present, advised the members to use the state organizations to secure concessions from the insurance companies. He outlined the policy of the mutual company, which the electric lighting companies had built up, and the advantages to both parties under this arrangement. He presented some interesting statistics, too, that showed clearly that electric plants were not as bad risks as the insurance companies would lead the world to believe. By insisting upon first-class construction work and frequent inspections much danger was removed. In fact, Captain Brophy proved pretty conclusively that electrical plants had proved a very desirable class of business for insurance companies.

ELSEWHERE in this issue is presented an excellent report of the proceedings of the convention of the American Street Railway association at Atlanta last week. The attendance, it will be seen, was large and representative and the papers presented for the consideration of members were of a practical character. A number of subjects were discussed that will appeal strongly to electrical engineers; in fact the meeting had a decidedly electrical character throughout. A majority of the members of the association operate electric roads and it was only natural, therefore, that matters pertaining the to construction, maintenance and operation of trolley lines would form the chief feature of the programme. The papers read at the convention treated of practical subjects; they were prepared by practical men and gave the result of practical experience. A glance over the list of papers and the names of their authors will convince anyone of the importance and the advantages of these gatherings to the street railway industries.

DISAPPOINTMENT is expressed in England over the result of the recent colonial conference held at Ottawa for the purpose of considering the trade relations existing between Canada and the Australian colonies and the best means of securing direct cable communication between them. As a matter of fact the conclusions of the conference were of such a character as to compel the belief that those interested in the scheme are not agreed upon a common line of action. Complaint is made that the governments represented do not know where they want the cables laid. It is pointed out, too, that before the conference the governments should have equipped and sent out a suitable steamer with a competent telegraph engineer on board, to report on the proposed landing places, and take the soundings necessary to enable a definite route to be approximately selected. The cost of such a preliminary survey, it is estimated, would perhaps have been about £10,000. With such information as could be readily obtained on a preliminary survey before it, the conference would be prepared to adopt some policy and make arrangements for a complete survey of the proposed route. At present nothing definite has been determined, and little progress can be said to have been made. In the meantime the French cable scheme is growing in favor, and there are excellent reasons for looking forward to important extensions at an early day.

AS an instance of the manner in which nearly all of the daily newspapers of Chicago misrepresent and prejudice public sentiment on the question of building overhead trolley railroads through the streets, the recently published letter of William W. Bell is worthy of wide dissemination. Mr. Bell owns considerable property fronting on Forty-seventh street, and he writes to the *Evening Post* to correct a mistake made by that journal, which, in a characteristic, cocksure manner, asserted that the property owners of the street would fight the introduction of the proposed electric line, for which the Chicago City Railway company has a franchise. Mr. Bell is "heartily in favor" of the improvement, and so is a majority of the Forty-seventh street property owners with whom he has discussed the subject. He shows how the street will be benefited, and concludes his letter as follows:

As an illustration I will give an instance told me by one of the owners on Forty-seventh street east of Drexel boulevard. Before the electric road was built on that street, west of Cottage Grove avenue, vacant lots sold for from $30 to $60 a foot. The same property now sells for from $200 to $500, and is in demand for large and fine business blocks. The property owners on Forty-seventh street east of Cottage Grove avenue will be greatly benefited by the extension of the trolley electric road to the lake, and I, in common with others, hope to see the cars running on that street within the next sixty days.

A candid statement of fact like this will counterbalance many columns of editorial bombast about the iniquity of the trolley system.

IN view of the interest manifested in the subject of utilizing the cable and electric roads of Chicago for handling mail matter, the paper presented by Richard McCulloch of St. Louis on this topic at the Atlanta convention is timely. There has been more progress made in this line than is generally known, not a few companies doing a considerable express and freight as well as passenger business. According to Mr. McCulloch's figures there are 58 roads handling mail matter under contract with the government and four others are engaged in similar service under sub-contracts. Besides these, there are 35 companies engaged in express business and 55 are transporting freight. But the greatest interest surrounds the mail service. In St. Louis and Brooklyn this service has reached the highest state of perfection. On one line in the former city there is a separate car especially constructed for this service and in charge of a railway mail clerk. This was described to illustrate the system. The line begins in the business part of the city and runs through the choicest residence district and suburban settlements of the town of Florrissant, 16 miles from the center of the city. The down-town portion of the road was formerly a cable, and the suburban part a narrow-gauge steam line, but the grip and locomotive have been discarded and the road is now electric throughout its entire length. The mail car makes three trips each day, two through to Florrissant and one as far as the city limits. The railroad company furnishes a conductor and motorman, while the Postoffice Department supplies the mail clerks. Practically the same system that has been employed on steam railroad lines is followed here in collecting, handling and distributing the mail. The advantages of this plan are obvious. The mail is quickly and promptly handled; the service is regular and certain; great and small quantities of mail may be collected and distributed with equal facility; the residents along the line are greatly accommodated, and no interruption or inconvenience to the passenger traffic need result. It is certainly an important addition to the mail service in large cities, and one which should be thoroughly developed.

IT is an undoubted fact that while British electricians are very willing to profit by the lessons of the pioneer electrical work in the United States, they are more ready to point out the crudities which they, as adapters, are enabled to avoid, than to admit their obligation to the enthusiasm, persistence and ingenuity of the American originators. This is hardly fair. The engineers and public of Great Britain are entitled to be as conservative as they please in the matter of electrical development; but if they do profit by the advanced state of practical electrical application in the United States, it can only be a touch of national jealousy that prevents a proper acknowledgment of the fact, so long as our British cousins insist upon making comparisons.

That the exponents of the electrical industry in England are perfectly willing to lie back and avail themselves of the refinements of American practice, as developed by the hard knocks of every-day experience, is a fact familiar to all conversant with the state of the art in Great Britain and the United States. H. D. Wilkinson, an English electrical engineer who made an extended tour of inspection throughout the United States last year, has embodied the results of some of his observations in an appreciative paper entitled "Notes on Electric Tramways in the United States and Canada." In an editorial notice of this paper, which is mildly sarcastic rather than entirely just, the London *Electrician* says, referring to electric railway men in the United States: "They have purchased experience at heavy cost, which should benefit us when our turn comes." And again, after alluding to the unpromising prospect for the development of the electric railway in England: "Meanwhile, the only thing to be done is to make due preparation, and as an aid to that end to purchase the dearly bought experience of others at a cheap rate." The *Electrician* has no word of praise for the energy and perseverance, often manifested in the face of most discouraging obtacles, which have made the "experience" which it now coolly proposes to utilize. On the contrary, it rather regrets the "optimism, cheery nonchalance and fondness for 'sonorosities' which distinguish the Anglo-Saxons of America from those of Great Britain." Perhaps the traits which our contemporary names are, when exaggerated, national defects of character. But, at any rate, they are characteristics that make for advancement and progress in the national life; and we cannot but think that in so cheerfully pointing out the mote of crudeness in our eye, our English friends have neglected the beam—shall we say, of mingled jealousy and ingratitude?—in their own.

Mr. Wilkinson, to judge by the opening installment of his paper, is very cordial in recognizing the merits and practical success of electric street railways in the United States. Just at this time, at the close of the successful meeting of the American Street Railway association in Atlanta, it is of particular interest to note the pleasant reference which he makes to the annual gatherings of this organization. Mr. Wilkinson speaks of the association as a "very energetic body," and says that its members "think nothing of traveling 1,000 miles to be present at their annual conventions." He notes also that "members practically own the town during their stay; the largest hotels are full, rooms being taken by representatives of different concerns as temporary offices." He also speaks of his "very pleasant participation" in the Milwaukee convention, and was evidently much impressed with the size and enthusiasm of the whole affair.

## Delegates and Visitors.

Following is a list of delegates and visitors at the convention of the American Street Railway association, Atlanta, Ga., last week:

Ackerman, P. C.....New York.
Acton, W. F.....Norwood, Conn.
Akerman, J. A.....Worcester, Mass.
Allen, E. H.....Philadelphia.
Allen, J. C.....St. Louis.
Anderson, A. A.....Youngstown, O.
Ash, G. W.....Gordonsville, Pa.
Atkinson, J. A.....Cleveland, O.

Baird, M. E.....Windsor, Conn.
Baker, R. S.....Washington, D. C.
Ball, F. H.....New York.
Barnes, C. E.....Plymouth, Mass.
Barr, B. M.....Cleveland, O.
Bartlett, C. H.....Manchester, Conn.
Bayliss, R. N.....Cleveland, O.
Beackle, R. H.....Boston.
Beadle, E. A.....New York.
Beale, R.....Washington, D. C.
Bean, W. W.....St. Joseph, Mich.
Beetern, J. R.....Scranton, Pa.
Belden, D. A.....Aurora, Ill.
Bennett, J. R.....Chicago.
Benscoter, C. A.....Knoxville, Tenn.
Berg, M. A.....Chicago.
Bibber, C. E.....Boston.
Bickford, J. H.....Salem, Mass.
Blackwell, J. H., and wife.....Trenton, N. J.
Boughton, W. E.....New York.
Bowen, W. H.....Cleveland, O.
Boyd, F. C.....New Haven, Conn.
Breed, A. F.....Boston.
Breed, E. L., and wife.....New Britian, Conn.
Bradford, H. C.....Cincinnati.
Bradley, C. A.....Waterbury, Conn.
Brown, R. S.....Boston.
Bushnell, E. M.....Easton, Pa.
Butler, A. E.....Lawrence, Mass.

Candee, W. L., and wife.....New York.
Carson, J. H.....New York.
Case, F. R.....Philadelphia.
Case, J. I.....Racine, Wis.
Chur, Walter.....New York.
Cicott, Frank X.....Boston
Clark, W. C.....Pittsburg, Pa.
Clark, E. M.....Scranton, Pa
Clark, C. D.....Boston
Clark, C. M.....Scranton, Pa.
Clark, C. P.....Boston.
Coie, W. W.....Elmira, N. Y
Colgate, G. L.....New York.
Collins, W. Forman.....Chicago
Connette, E. G.....Nashville, Tenn.
Cooke, W. E.....New York
Cooke, W. J.....Chicago.
Coolidge, Daniel.....Johnstown, Pa.
Crisson, G. A.....New York.
Crisson, G. A.....New York.
Crossman, T. E.....Brooklyn, N. Y.
Crowley, H. W.....Shamokin, Pa
Cummings, J. M.....Philadelphia.
Cunningham, G. E.....Montreal, Can
Cunningham, J. H.....Boston.

Daniels, G. C.....New York.
Davis, F. H.....Williamsport, Pa.
Davis, H. W.....New York.
Degenhardt, F. E.....Chicago.
Devon, G. N.....
Dimmick, W. T.....Omaha, Neb.
Dodge, G. A.....New Haven, Conn.
Dodge, George A.....New Haven, Conn.
Douglas, E. S.....Tampa, Fla.
Duncan, D. J.....Carbondale Pa.
Dunlap, G. T.....Washington, D. C.
Dyer, D. B.....Augusta, Ga.

Elkins, Wm. L.....Pittsburg.
Ellis, L. J.....New York.
Eno, W. Y.....Wilkesbarre, Pa.
Evans, H. C.....New York.
Evans, D. E.....Gainesville, Ga.

Fairchild, C. B.....New York.
Faucett, E. V.....Philadelphia.
Field, J. M., and wife.....Washington, D. C.
Field, C. J.....New York.
Flanders, C. Y.....Philadelphia.
Foster, H. O.....New York.
Foster, H. H.....New York.
Freeman, T. L.....Chicago.
Fulton, F. G.....New York.

Gann, R.....St. Louis.
Goodrich, E. S.....Hartford, Conn.
Graham, John.....Wilkesbarre, Pa.
Granten, T.....New York.
Green, O. C.....Washington, D. C.
Greene, B. E.....New York.
Greenwood, Jr., I.....New York.
Griffin, J. B.....Hamilton, Conn.

Hagebrigg, S. F.....Youngstown, O.
Hamilton, B. G.....Cincinnati.
Hanna, J. A.....Philadelphia
Hanna, J. B.....Cleveland.
Harding, H. McL.....New York.
Harrington, W. E.....Philadelphia.
Harris, G. H.....Birmingham, Ala.
Harris, B. F.....Champaign, Ill.
Hatch, E. B.....Hartford, Conn.
Hawkins, T., and wife.....Rockland, Me.
Heinrichs, R. D.....Newark, N. J.
Heinrichs, E. H.....Pittsburg.
Henlings, W. H.....Philadelphia.
Henry, W. L.....Boston.
Hertz, J. H.....Macon, Ga.
Higgins, G. E.....New York.
Hoagland, C. A.....New York.
Hoffman, A.....Chicago.
Hubinger, J. C.....Keokuk, Iowa.
Hunt, Walter.....New York.
Hunter, W. J., and wife.....New York.
Huntress, F. E.....New York.
Hurley, P. E.....Trenton, N. J.
Hurt, Joel.....Atlanta, Ga.
Hurt, N. H.....Atlanta Ga.
Hollock, H. H.....Elmira, N. Y.

Issertel, H. G.....New York.

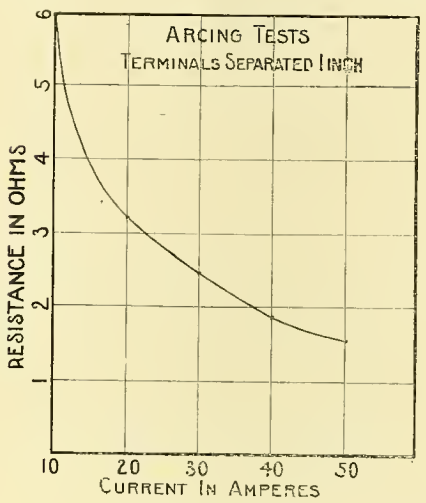
Jackson, J. H.....Wilmington, Del.
Jackson, Gen. W. H.....Nashville.
Jenison, Frank.....Birmingham, Ala.
Jenkins, Thos. M.....Cincinnati.
Jewell, W. S.....Toledo, O.
Johnson, J. S.....Grand Rapids, Mich.
Johnston, W. J, and wife.....New York.

Kenfield, H. J.....Chicago.
Kilgore, John.....Cinci nati.
Kimball, T. M.....Boston.

King, C. K.....Mansfield, O.
King, P. W.....St. Louis.
King, P. M.....St. Louis
Knight, F. H.....Easton, Pa.
Kohler, G. A. E.....Chicago.
Kohler, F. W.....Chicago.

Landon, E. T.....New York.
Lawless, E. J.....New York.
Lnburg, W. H.....Trenton N. J.
Littlefield, A. I.....Chicago.
Longbridge, J. E.....Philadelphia.
Longstreet, D. F.....Denver.
Lord, D. F.....Boston.
Lovejoy, J. P.....Schenectady, N. V.
Luscomb, H. S.....New York.

Macomber, E.....Augusta, Me.
Mallochee, H. J.....New Orleans, La.
Martin, N. E.....Lawrence, Mass.
Martin, T. C.....New York.
Martin, E. W.....Hamilton, Ont.
Mason, W. R.....Chicago.
Mendell, C. S., and wife.....New Bedford, Mass.
McAdoo, W. R.....Paterson, N. J.
McCallister, H.....Camden, N. J.
McCardell, J. R.....New York.
McCleary, I. B.....Birmingham, Ala.
McCullough, R.....St. Louis.
McGraw, J. H.....New York.
McNamara, Jno. W., and wife.....Albany, N. Y.
McLean, Thos. H.....Indianapolis.
Meir, E. D.....St Louis.
Minary, T. J.....Louisville, Ky.
Moore, W. E.....Augusta, Ga.
Morgan, J. W.....Camden, N. Y.
Morse, G. C.....Rochester, N. Y.
Meyers, B. T.....Wilkesbarre, Pa.
Notley, G. F.....Jamestown, N. Y.
Musser, F. B.....Harrisburg, Pa.
Myers, L. E.....Chicago.
Myers, Garson.....Chicago




A REVIEW OF THE UNDERWRITERS' RULES COVERING THE USE OF 500 VOLT FUSES.

Nagle, J. W., and wife.....Philadelphia.
Newbert, W. F.....Chicago.
Nyman, H. S.....New York.

Odell, C.....Boston.
Oliphant, John.....Chicago.
Ostrom, J. F.....Shelton, Pa.
Outcault, R. F.....New York.

Packer, E.....New York.
Paige, Alonzo W.....Chicago.
Parker, J. G.....Washington, D. C.
Partridge, Col. J. N.....Brooklyn, N. Y.
Partridge, James.....Sandusky, O
Patterson, W. H.....Bloomington, Ill.
Payne, H. C.....Milwaukee.
Pearson, Henry.....Springfield, Mass.
Pearson, B.....New York.
Peckham, E.....New York.
Pennington, T. C.....Chicago.
Perkins, T. G.....Manchester, Conn.
Perrine, Lewis.....Trenton, N. J.
Perry, Jas. H.....Philadelphia.
Pierce, G. W.....Stanford, Conn.
Platt, Mason D.....Streeton, Pa.
Pond, A. C., and wife.....Winchester, Conn.
Pool, H. W.....New York,
Porter, George F.....New York.
Pound, A. E., and wife.....New Haven, Conn.
Powers, E. L.....Chicago.
Pratt, Charles B.....Worcester, Mass.
Pratt, Geo.....Wilmington, Del.
Price, C. W.....New York.
Pugh, D. W.....New York.

Record, E. A.....Poston.
Richardson, H. C., and wife.....New York.
Richardson, W. J., and wife.....Brooklyn.
Robinson, W.....Boston.
Rose, R. M.....Norwood, Conn.
Ross, Ed. L.....Indian Orchard, Mass.
Russel, F. D.....New York.
Rutherford, J. A.....Pittsburg.

Schieren, Jr., Charles A.....Brooklyn.
Seely, J. A., and wife.....New York.
Seguine, W. P., and wife.....New York.
Seibel, G. C.....Taunton, Mass.
Shaffer, W. H.....Asbury Park, N. J.
Shaler, A.....New York.
Shaw, Warren.....Boston, Mass.
Shaw, E. P.....Amesbury, Mass.
Shepa dson, A. O.....Waterbury, Conn.
Sherman, Allen.....Racine, Wis.
Silver, W. S.....New York.
Simmons, E. A., and wife.....New York.
Skinner, Harvey.....Chicago.
Sloane, F. H.....Baltimore.
Smith, T. H.....Troy, N. Y.
Smith, U. N.....New Orleans.
Smith, J. F.....Fishkill, N. Y.
Smith, E. U.....Philadelphia.
Smith, F. A.....Omaha, Neb.
Smith, Ed. N., and wife.....Philadelphia.
Somersett, H. J.....Winnipeg.
Sperry, E. A.....Cleveland.

Staley, J. S.....Cleveland.
Stanwood, F. H.....Chicago.
Stedman, J. H.....Rochester, N. Y.
Stevenson, S. N.....New York.
Stillman, F.....Brooklyn.
Stone, E. K.....Quincy, Ill.
St. George, P. W.....Montreal, Can.
Stump, C. E.....New York.
Sullivan, M. J., and wife.....Chicago.
Sweetzer, D. H.....E. Middleton, Mass.

Taylor, W. H.....Chicago.
Taylor, W. H.....Buffalo.
Taylor, W. H.....New York.
Thompson, S. B.....Baltimore, Md.
Tindolph, E. F.....Vincennes, Ind.
Titus, A. C.....Newport, R. I.
Tolles, C. L.....Hartford, Conn.
Tomkins, C. M.....Elmira, N. Y.
Traggoart, J. G.....Pittsburg.

Vail, J. H.....New York.
Vandergrift, F. C.....Philadelphia.
Van Fleet, C. W.....New York.
Vincent, Chas. R.....New York.
Vosburg, A. C.....Syracuse.

Wakefield, R. S.....Dallas, Tex.
Wallace, A.....Columbia, S. C.
Watkins, John.....Carbondale, Pa.
Wessells, E. J.....New York.
Wheeler, S. E.....Philadelphia.
Whipp, G. S.....Brooklyn.
White, T. C.....St. Louis.
Wilkinson, W.....New York.
Williams, C.....Manchester, Conn.
Winser, H. J.....New York.
Woodard, C. F.....Wakefield, Mass.
Woodruff, R. S.....Trenton, N. J.
Woodruff, J. A.....New York.
Wyman, C. D.....Milwaukee.

## A Review of the Underwriters' Recent Rules Covering the Use of 500 Volt Fuses.

By Walter E. Harkington.

The writer recently received a pamphlet from the Board of Fire Underwriters containing a description of a series of tests to determine the safe length of fuses of different capacities in amperes for 500 volt circuits. The deductions from the above tests were formulated as rules of practice for users of 500 volt circuits. The tests were conducted by a committee representative of the several boards of fire underwriters throughout the United States. A copy of the tests and tabulated results is attached as an appendix to this paper.

A careful perusal of the appendix will show that great care was observed by those conducting the tests in question, and if the practical use of fuses, particularly the conditions under which a fuse "blows," were in any wise similar to the requirements as prescribed, then the tests and results should not be open to criticism. Unfortunately the "blowing" of a fuse is an accident, and an accident is an occurrence over which we have no control; it is just as likely for a short-circuit to occur on a circuit containing, say, a ten ampere fuse, as it is to have a condition of circuit wherein just the ten amperes, the minimum current required to "blow" the fuse, will flow.

The sole reason for making the tests was to determine the dimensions of fuse blocks that would overcome the arcing phenomena attendant upon the "blowing" of 500 volt fuses in lower voltage fuse blocks, the only type heretofore available for use.

As will be noticed, the tabulated results state specifically the safe lengths in inches for different capacity fuses, ranging in size from 10 amperes to 100 amperes in 10 ampere steps; further, the results as obtained were based on the one condition that the current in amperes flowing at the time of fusion was the minimum current causing fusion. In addition to the foregoing, attention is called to the better protection afforded by using a bridge.

The writer intends to demonstrate, by both the results of practice and specially conducted tests, the absurdity of promulgating the results of such incomplete tests as the basis for formulating rules in the matter of the protection of 500 volt circuits.

Since the arc accompanying the "blowing" of a fuse is the thing to be avoided, or, rather, mitigated, tests were conducted with a view of determining the properties of an arc under the same conditions, as regards length, with different currents. Pieces of No. 8 B. & S. gauge copper wire were cut and mounted horizontally, an inch apart longitudinally: an arc was established between these terminals with ten amperes; note was taken of the ohmic resistance; next, twenty amperes was caused to flow, and again note was taken of the ohmic resistance. This process was repeated for currents in ten ampere steps to fifty amperes, in each instance note being taken of the ohmic resistance. The curve represented in the accompanying cut shows graphically the relation borne by current flowing through the arcing interval of one inch and its corresponding ohmic resistance. It will be noticed, and to this fact the writer would draw particular attention, that the ohmic resistance drops off very rapidly as the current increases. The results, as obtained, show beyond a peradventure of a doubt that under conditions of a short-circuit the ohmic resistance of the arc is neglible.

The decrease in resistance in the arc as the current in-

creases is unquestionably due to the greater volume and therefore greater cross-section of the gas formed, as it does not seem possible that the specific ohmic resistance of the gases should materially vary. It is interesting here to make note of the fact that the slightest movement of the air in the vicinity of the arc caused a variation in the resistance.

The foregoing establishes positively that if a given length break in a fuse block protects for one maximum current, it may not for greater currents. The entire and sole cause of the protection afforded in a break caused by fusion is due directly to the resistance interposed in the circuit by such fusion and the tests show that such resistance becomes less as the current grows greater.

In order to read the almost instantaneous currents due to short-circuits, a magnetic circuit breaker of the C-S automatic type was taken and calibrated to open on different adjustments, ranging from 38 amperes to 400 amperes. Different lengths of No. 30 B. & S. gauge copper wire were tested in series with the C-S circuit breaker directly across the 500 volt bus-bars of the switchboard of the Camden Horse Railroad company, thus making an absolute short-circuit. In every instance, for each length of the No. 30 B. & S. gauge copper wire, ranging from one inch to eight inches, with and without bridge, upon making a short-circuit the C-S circuit breaker set for 400 amperes was opened.

Here is an exceedingly interesting state of affairs—a copper wire which will fuse upon the passage of about two amperes allowing 400 amperes to pass upon a short-circuit, and then not protecting the circuit in which it was placed, for the magnetic circuit breaker opening was the immediate cause of the breaking of the arc established by the "blowing" of the fuse. This latter deduction is not correct, because a No. 30 B. & S. gauge copper wire will really only permit the passage of 40 amperes upon a 500 volt short-circuit. The question naturally arises. How did 400 amperes come to flow? The answer is readily given in the light of the knowledge we have of the properties of arcing, and is: This excessive current flows not through the fuse but through the arc maintained at the expense of the terminals, the fuse simply playing the role of establishing a condition. In a long series of experiments covering another field of research, but wherein almost innumerable fuses of different capacities and lengths were employed in making 500 volt short-circuits, in no instance was the circuit protected by the fuse, but by the opening of the main magnetic switchboard circuit breakers. In many instances, fuses made of No. 22 B. & S. gauge copper wire six inches long have opened circuit breakers requiring 800 amperes to open.

There exists a popular misconception of the action of bridges. A bridge is an additional protection, as it increases the length of the arc, other dimensions remaining the same, but as we approach short-circuits the little additional length due to the bridge does not figure, and the repeated tests made by the writer emphatically confirm this fact.

The ideal and not impracticable fuse block for the protection of 500 volt circuits is not one with a great breaking distance, neither one with a bridge, but one with protected terminals. This type permits the blowing of the fuse only, without the attendant arcing, always vicious and destructive of the terminals.

In conclusion, a 500 volt circuit is not protected by the forms of cut-outs recommended by the International Electric association; further, it is absolutely dangerous to adopt such precaution, as the continued arcing which would ensue in event of a short-circuit would easily ignite any inflammable material in the immediate vicinity. This latter claim is confirmed by the frequent instances of car and car house fires.

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UNDERWRITERS' INTERNATIONAL ELECTRIC ASSOCIATION.—REPORT OF THE ELECTRICAL COMMITTEE.

*Length of Fuses.*

The following result of tests to determine the length of arcs maintained on 500 volt circuits when carrying currents ranging in amount from 10 to 100 amperes will be interesting. and give data which will enable inspectors to judge of the length of fuse necessary for various amperages in such circuits.

*General Description.*

A special slate fuse block one inch thick, three inches wide and twelve inches long was used, with heavy composition terminals. One of each was fastened to a brass strap embracing the block, making it possible to adjust the length between terminals at will. A water resistance for regulating the current was connected in series with the fuse block. Fuses of various sizes were placed in the block in a vertical position, and a steady current maintained till they melted. Beginning with 10 amperes, observations were taken at intervals of 10 up to 100 amperes.

*Method Followed in Making Tests.*

The test throughout was conducted in the following manner: At each interval of 10 amperes the terminals were at first placed close enough together to establish an arc when the fuse melted. The distance between them was then increased a quarter of an inch, and if arcing again took place the operation was repeated until no arc was formed. When this point was reached, two more fuses were melted under the same amount of current, and if no arcing occurred in the three successive trials, it was considered a safe length for fuses whose melting point corresponds to the current used.

In every case the largest fuse was used that could be melted within about five minutes, for it was found that when a fuse melted quickly, no arc occurred at distances at which heavier fuses readily maintained one. Whenever even a momentary arc was formed that distance was regarded as unsafe, and longer ones taken till no arc occurred on three trials.

*Covered Fuses.*

Tests were made to ascertain what effect enclosing the fuse in a box had on the arcing distance. It was found that covered fuses should have at least a quarter of an inch more length between terminals, while a half inch would be more satisfactory.

*Effect of Bridge Between Terminals.*

The terminals were moved to within 1¼ inches of each other, and an asbestos-covered bridge, the width of the fuse block and 2½ inches high, placed between them. With 100 amperes there was no tendency to arc, whereas, with a straight fuse, 4 inches was the minimum length at which no arcing occurred. Instead of nearly all the fuse melting, as was the case with straight fuses, only about an inch or less dropped out.

By employing a bridge of proper material, it is thus possible to use a much shorter fuse block. Such a block is in every respect as safe as the ordinary form, and obviates the vicious fusing that occurs with straight fuses on 500 volt currents.

*Effect of Excessive Current on Small Fuses.*

In order to determine the effect of large currents on small fuses, a current of 150 amperes was passed through a fuse rated to melt at 10 amperes. The length of the fuse on the first trial was one-half inch, the safe length determined by the foregoing experiments. The length was increased by one-half inch steps up to one and one-half inches, and the effect noticed at each length. In no case was a continuous arc maintained, although with the one-half inch fuse the flash was quite bad, burning the terminals slightly. The same results were obtained on all of the longer lengths. This tends to show that on circuits of a large capacity the only safe fuse is either one provided with a suitable bridge or one of excessive length.

*Data.*

The following data give the maximum length between terminals at which arcing occurs, the minimum length at which no arcing was observed, and the safe lengths on 500 volt circuits for fuses whose melting points are identical with the various current strengths designated:

| Amperes. | Maximum Length at which Arcing Occurred. | Minimum Length at which no arc was observed. | Safe Lengths. |
|---|---|---|---|
| 10 | ¼ inch | ½ inch. | 1 inch |
| 20 | ½ " | ¾ " | 2 " |
| 30 | 2 " | 2 " | 2¾ " |
| 40 | 2 " | 2¼ " | 3⅜ " |
| 50 | 2¼ " | 2½ " | 3½ " |
| 60 | 3 " | 3½ " | 3¾ " |
| 70 | 3 " | 3¼ " | 4 " |
| 80 | 3¼ " | 3½ " | 4⅛ " |
| 90 | 3½ " | 3¾ " | 4¼ " |
| 100 | 3¾ " | 4 " | 4½ " |

## Mail, Express and Freight Service on Street Railway Cars.[1]

By Richard McCulloch.

In order to ascertain as well as possible how much has already been done, a circular asking for information in regard to mail, express and freight service was sent to every street railway company in North America. Nine hundred and seventy-eight letters were sent out, and four hundred and thirteen replies were received. These replies are tabulated below. As a great many railways were not heard from, it cannot be assumed that the table is absolutely correct, but it is probable that most of the railways having such a service answered the circular. Roads which are enumerated as having express or freight services are only those which have this service fully developed. The carrying of packages by conductors of passenger cars was not called express service, but is enumerated in a separate column. From some of the states, notably Pennsylvania, Rhode Island and Massachusetts, it was reported that the transportation of express and freight by street railways was prohibited by state law, and many of the companies answered that their franchises allowed only the transportation of passengers.

The rate charged on express matter is usually five or ten cents per package, while the freight rates vary from four to ten cents per 100 pounds. The mail is usually carried either under a direct contract with the government or under a subcontract with a mail contractor. The income from the transportation of the mails varies, according to the amount of mail, the number of trips per day and the length of the haul, from $100 to $1,000 per annum.

1. Abstract of report read at the thirteenth convention of the American Street Railway association, Atlanta, Ga., October 17, 1894.

TABLE OF MAIL, EXPRESS AND FREIGHT SERVICE IN NORTH AMERICA.

| | Any form of such service. | Under contract with express Co. or U. S. Government. | Haul steam R. R. freight cars over street R. R. tracks. | Operate special cars for this service. | Carry small bundles on passenger cars for pay. | Contemplate such service. | Distribute matter beyond station. | Use combination express and passenger car. |
|---|---|---|---|---|---|---|---|---|
| Mail | 62 | 58 | ..... | 5 | ..... | 10 | ..... | ..... |
| Express | 35 | 8 | .. | 9 | 31 | 7 | 2 | 8 |
| Freight | 55 | ..... | 6 | 37 | ..... | 12 | 2 | ..... |

MAIL SERVICE.

That the street railways of this country are already alive to the possibilities of the mail service is shown by the table. Sixty-two street railways are now carrying Uncle Sam's mail, while fifty-eight have government contracts. Most of these railways are suburban roads or roads joining towns; but the postal authorities, realizing the advantage of quick delivery and collection, are now beginning to make arrangements with the large city systems for transportation of the mails from main postoffices to branches and for distribution and collection throughout the city.

Various methods of utilizing street railways for this purpose have been proposed by different local postoffice authorities. In one large western city, in which all the roads are controlled by one company, it was proposed to equip one car of each line with a mail receptacle. At stated times, the carriers along the route were to meet this car and drop into the receptacle all the mail collected by them, which was in turn to be taken from the receptacle as the car passed the main postoffice. This plan, however, did not meet with the approval of the great fathers at Washington, and in consequence was abandoned by the local authorities. Any system of this kind would greatly expedite the collection of mails, but the weak point seems to be that no provision is made for their distribution.

The only method of handling a large mail service, in which it is necessary to collect and distribute along the route, and handle it satisfactorily both to the patrons of the road and the Postoffice Department, seems to be in the use of a separate car—an independent mail car in charge of a railway mail clerk. This system is already in use on s reet railways in St. Louis, Brooklyn and several other places, and so far as we can learn is giving excellent satisfaction, both to the railway companies and the postoffice authorities. The mail is quickly and promptly handled; the service is regular and certain; great and small quantities of mail may be collected and distributed with equal facility; the residents along the line are greatly accommodated, and no interruption or inconvenience to the passenger traffic results.

As an example of such a service, it would probably be interesting to describe the operation of a United States mail car, which has been run by a street railway in St. Louis for some time. The St. Louis and Suburban railway begins in the business part of the city and runs through the choicest residence and suburban settlements of the town of Florrissant, sixteen miles from the center of the city. After leaving the city limits, the line penetrates the beautiful Florrissant valley, thickly dotted with pleasure resorts, country clubs, summer homes and suburban villas. The down-town portion of the road was formerly a cable and the suburban part a narrow-gauge steam line, but with the onward march of progress, the grip and the locomotive have gone to join the mule car, and the road is now electric throughout its entire length. The mail car makes three trips each day, two through to Florrissant and one as far as the city limits. The railway company furnishes a conductor and motorman, while the Postoffice Department supplies the mail clerks. The car, which was built especially for this purpose, is equipped with its own motors, and is furnished with the necessary desks, cases, racks for mail bags, etc. At a schedule time it is run up in front of the postoffice and receives the mails put up in pouches from a wagon there to meet it. The mail clerk receives a bag for each station outside the city limits, and for each carrier along the route a bag designated by his number. He also receives all mail which has come in too late for assortment, which is distributed on the car to the proper bags before reaching the first station. Letters are received, canceled and distributed on this car, just as in the ordinary steam railroad mail car. The first stop is at a point about one and a half miles from the postoffice At this point six carriers meet the car, and each carrier receives from the mail clerk the pouch bearing his number. Another stop is made about two miles out, another two and a half, another three, and another four miles from the postoffice. Any mail for the suburbs is handed to the mail clerk by the carriers and dropped into the proper bag by him. After the city limits are passed, bags are exchanged at each station just as on a steam railroad. On the return trip the same system is followed until the city limits are reached. Within the city, the postoffice department has placed letter boxes at the principal corners along the line. Each carrier brings the mail collected in his district to the nearest box on the line of the railroad. Stops being made at each box, the mail clerk removes the mail, and assorts it before arriving at the next station. The letters thus canceled and assorted are delivered at the main postoffice, tied up in bundles ready for shipment. The mail car makes no stops for passengers, and for this reason can easily keep out of the way of the passenger cars. A light freight business is also done on the car. Provisions, light furniture, milk, trunks, etc., are carried, and the charges collected by the conductor. The mail service has now been in operation three years. New features are constantly being added to it, and, aside from the accommodation afforded the residents of the territory through which the road runs, it is a source of profit to the railway company.

The system just described seems the best that has yet been devised for the handling of a large mail business. Where the mere carriage of the mails in pouches from the

main postoffice to branches, or from depots to post offices, is undertaken, and there is no attempt made at collection or distribution along the route, there can be no objection to carrying the mail sacks on the front platform, if their number is not too great, but passenger cars should not be stopped and held for mail collections, nor should valuable space within a passenger car be taken up with mail sacks.

The question as to whether or not mail service is called for depends almost entirely upon local conditions—the length of the road, the territory through which it runs, the proximity of depots and postoffices to the line of the road, and many others. An advantage in estimating the advisability of inauguratiog a mail service is that a certain, fixed income may be assumed, which is not the case with any other service. It is usual in government contracts to pay a certain sum per one hundred pounds per mile, the weight being determined at stated intervals by weighing the mail. For this reason a certain fixed income is assured during the interval. A number of cases may be cited in which it would be well for the managers to look into the profits which might accrue from a mail service. Large city systems covering various parts of the city and passing close to postoffices and public building would afford great advantages in distributing and collecting the mails. Suburban roads, roads connecting towns, and those running to depots in the outskirts of the city are other instances of openings for mail servicee.

An advantage, independent of any financial return, and one which is regarded by many as the one reason for street railways embarking in the service, lies in the prestige of Uncle Sam's name. This point was never so thoroughly illustrated as in the late labor troubles in Chicago. Rioters may have no fear of the city police or of the state militia, both of whom are often entirely in sympathy with them, but they regard with the greatest awe a company of regulars armed with Springfield rifles. Uncle Sam will tolerate no interference with the distribution of the mails, and no other point has been so thoroughly impressed upon the dangerous element in our communities during the last year. Some railway managers on securing mail contracts have proposed to paint upon each car, "U. S. Mail," as a kind of official notice that their roads are under the protection of the government. How effective will be the protection against blockades and riots, and how great a moral influence this will exert to prevent strikes and other stoppages, remains to be seen.

EXPRESS AND FREIGHT SERVICE.

The answers to the circulars showed that thirty-five roads are now engaged in the express business, while fifty-five are hauling freight. As a matter of fact, however, few roads through the country are doing a regular freight business, most of the so-called freight services partaking more of the nature of express. As operated upon street railways, the distinction between express and light freight service is so ill defined that it is deemed best to consider both subjects together.

There are many points in the street railway as now conducted which make it almost an ideal agent for the transportation of packages and light freight. The great number of points reached by the cars, the absolute certainty with which they run, the thousand and one precautions taken against any stoppage of however short a duration, the rapidity with which distant points are reached, and many other causes combine to make the street railway of to-day a common carrier of exceptional advantages, when only short distances are considered. Many conditions will suggest themselves to railway managers in which an express or freight service may be made a paying institution. In the case of a town in which the railway station is some distance from the business part of the town, there can be no quicker, safer and better plan of conveying express and freight to some distributing point in the heart of the town than by the street railway. Whether or not this will pay depends upon the amount of material, the competition, the distance and the scope of the street railway franchise. A case often met with through the country is that of two towns connected by an electric railway, one of which, having no steam railroad, is obliged to get all its supplies through the other town. The installation of a freight service of some kind would at once suggest itself in this case, and the profits would depend upon the size of the towns, the character and occupations of the inhabitants, the distance between the towns, etc.

The operation of an express service on large city systems has not been attempted to any great extent, but it has been contended by some enthusiasts on the subject that a street car express service will eventually take the place of the many city deliveries and city express wagons now in use. As an example of a city road operating an express and freight service involving collection and a house to house delivery, it would be interesting to cite the case of the Southern railway of St. Louis, which has been operating an express service on this plan for almost two years. The Southern electric railway begins in the heart of the city, and runs in a southerly direction for seven miles, following the general direction of the river to Carondelet. The territory penetrated is thickly settled for almost the entire distance, and in no essential does the road differ from the ordinary city street railway. Three trips per day are made upon schedule time by the express car, which is entirely independent, being mounted upon motors of its own. At the down-town end is a receiving station, where a clerk receives all express consigned to the company, and keeps all the books pertaining to the service. The especial feature of this service, however, is the collection and delivery. This is effected by means of wagons, two of which are kept at the down-town end of the road, and three of which meet the car on all trips at certain points along the line. On receiving notice by mail, telephone, or otherwise, a wagon calls for a package, delivers it at the car, from which it is handed to the proper wagon, and delivered to the address marked on the package. A charge of ten cents per package is made for this delivery, and trunks are taken from houses to the Union depot, checked, and the checks returned, for the sum of fifty cents. A corresponding charge, according to size, is made for the delivery of large boxes and bundles. A compliment to the efficiency of the service is paid by the large dry goods and clothing houses, which have ceased to run their delivery wagons into this part of the city, and now consign all of their bundles to the railroad company. Where formerly one delivery daily was made by the wagons, three are now made by the railway. An interesting feature of the service is that several large factories located in the southern part of the city consign all their freight to the electric express. The goods are put on the car, taken to the proper railroad stations, shipped, and the bill of lading returned to the consignor. Packages are received by the express car C. O. D., the charges collected, credited to the proper account, and settlements made at the end of each month. The railway company assumes all the responsibilities of a common carrier, holding itself liable for all loss and damages. This, however, is a contingency which seldom occurs. The service has now been in operation for about two years. It is well patronized, both by the residents along the line and the large retail stores in the center of the city. It does not interfere with the regular running of the cars, and since its inauguration has never failed to pay.

Up to this point we have considered an express and freight service merely as a paying or non-paying institution, to be adopted in the one case and to be rejected in the other. There is another view which may be taken of the case, however, which is in many instances the most proper solution of the problem. This is to regard the establishment of this service merely as an auxiliary to the passenger traffic, to be operated whether or not it pays in order to gain increased passenger travel. The most notable instances of this sort are the roads which run from the hearts of our large cities out into the suburbs. It is manifestly to the interest of these roads to promote building and settlement along their lines, and how can they better attract builders than by giving their patrons all the advantages of city life, not only in furnishing them with rapid transportation to and from the city, but in aiding them in receiving their provisions and supplies. This calls for some form of express service, and although the receipts from this source may not equal the expenses, the increased passenger receipts and the advertisement given the road must also be taken into account.

In all street railway practice, the cardinal point of any service, whether mail, freight or express, must be that it does not interfere in the least with the passenger travel, and this point should always be kept in view in the arrangement of such a service. For this reason we would strongly advocate the use of separate cars, operated by separate motive power and by separate men. In roads between towns, or suburban roads operated on the same plan as a steam railroad, where stops are made only at certain stations, a combination car or a trailer might be used; but in city roads the system of piling trunks and boxes inside the passenger car and on the front platform, and stopping for these to be put on and taken off, is not of the era of the electric railway. Another system more fitted to the mule and the bobtail is the custom, yet in vogue in some places, of receiving small packages for transportation and allowing the conductor to deliver them along the route, stopping the car and forcing the passengers to wait. If the addition of a package service renders necessary such a reduction in the efficiency of the passenger service, it is difficult to perceive the gain in accommodation. A passenger car should carry passengers. It should stop and start for passengers alone, and it should reach the end of the road in the shortest possible time.

If mail bags may be thrown on the front platform of a car, carried to their destination and delivered without causing any long stops, this is perhaps the best way of solving a mail service on a small scale; but in a freight or express service it is better that the work should be done with cars especially devoted to such service and by men especially trained for it. A single box car equipped with motors of its own will handle the light freight and express of quite a territory without any interference with the regular running of cars. A twenty-five foot car, equipped with double trucks, supplied with the most approved form of motors and controllers, and fitted up either as mail car, express car, or combination car, can now be obtained for two thousand to twenty-five hundred dollars. A smaller car mounted on a single truck can be obtained for less money. If heavy freight is to be hauled, it should be carried in motor and trailer cars built especially for this purpose.

If it is proposed to establish a freight or express service, estimates should be made of the amount of business which could be procured, of its reliability, and of the rates which could be charged, taking into account the existing competition. On the other side, the cost of operating such a service should be estimated, allowing liberally for the time the investment is in idleness on account of nothing to do. If a reasonable assurance cannot be obtained of a steady and regular traffic, it is best not to venture into it, for an unreliable trade is liable soon to develop into a losing one. There are cases, however, as has already been pointed out, when it would be good policy to operate such a service at a loss, merely to give accommodation to patrons; and it is possible that a service, started for this purpose alone, might in a growing community develop into a paying one.

Before leaving the subject of express service it might not be out of place to give a brief description of a novel form, soon to be introduced upon the Union Depot Railroad of St. Louis, in which the freight is to consist of members of the genus *homo*, in a more or less disjointed state. This great railway system in its ramification extends to almost all parts of the city, passing nearly all of the city institutions, including the Dispensary, City Hospital, and several of the other hospitals, and at the desire of the city authorities it is now having built a hospital car. As designed, it is a twenty-five foot body, double truck car, having a double floor filled with asbestos to deaden sound. It is proposed to utilize it primarily in conveying patients from the Dispensary to the city and other hospitals. It can also be used in case of a great fire or calamity in which there are many injured and where the horse ambulances are not capable of handling the work. It is expected that other uses will develop for it after being put into service. The car is to be equipped with stretchers, folding chairs, a tank of water, apparatus for heating water by electricity, an emergency drug store, dressings, instruments, earth closets, and all necessary apparatus for taking care of the sick and injured. A surgeon is to be in charge of the car and will accompany it on all its trips. The car is now being built, and the innovation will, no doubt, be watched with a great deal of interest. It is intended by the city authorities to make arrangements to run the car over all the electric tracks in the city, as this will enable them to reach almost any point within the city limits.

Information received from several of the states, as before stated, shows that in some places the transportation of freight or express over street railway tracks is prohibited by state law or municipal ordinance, and it has been suggested that associations of managers of street railways in those states be formed, for the purpose of securing favorable legislation. The enactment of these laws may be due to hostile steam railroad influence or it may be due to a misconception of the nature of the services which street railways would put in operation. Surely, a smooth running electric car, moving swiftly onward, would not prove such a nuisance as the great lumbering wagons which block the streets of our large cities. Where a freight or express service is needed, the accommodation to the public would be so great that many citizens might be enlisted on the side of the railways to secure the proper legislation.

In closing, it would perhaps be well to note some of the principal points which, it is hoped, have been brought out in this paper:

1. That a mail service involving collection and distribution is best handled on a separate car, operated on the same plan as a U. S. railway mail car.

2. That it is supposed that a great advantage arising from the transportation of the mails comes from the fact that the road is under the protection of the government, and is thus secure from riots, strikes and blockades.

3. That the most promising opening for an express or freight service is a road running between two towns, or a city road running through well populated suburbs.

4. That the question, whether or not such a service will pay is entirely a local question, and must be estimated for each road separately, under existing conditions.

5. That there are cases when it would be advisable to operate such a service independent of the profits, in order to accommodate the patrons of the road and to induce building along the line of the road.

6. That such a service operated upon the ordinary street railway must not be allowed to interfere in the least with the passenger traffic.

7. That in states having laws prohibiting this service associations of railway managers should be formed to secure favorable legislation.

Five years ago such an institution as mail, freight or express service on street railways would not have been thought possible. Such a service has always been considered as a prerogative of the steam railroad, and the fact that some street railways have already gone into this business and that many others are engaged in investigating its merits goes to show how eagerly the street railway is encroaching on the domains of its elder brother, and it is not only in this respect that the electric railway is pushing the steam railroad, belt lines, suburban lines, dummy lines, summer resort roads, mining roads, and many others are rapidly being converted to the electric system. Everywhere we see instances of the screech of the locomotive being hushed by the busy hum of the trolley. We peer into the darkness of the future and we see great systems of railroads operated by power houses located in the neighboring coal fields; we see the great cities connected by electric lines, operated at marvelous speed, and perhaps at no distant date will some new "Empire State Express," or "999 Limited" be pointed out as the development of the electric street railway.

## A New Double Voltage Dynamo.

The Fontaine Crossing & Electrical company of Detroit, Mich., in offering the Fuller double voltage automatic constant potential electric machinery to users of electricity, calls attention to the superior advantages of a machine of this type, from the fact that it can be connected to any three-wire system without any alteration in wiring throughout the building, as well as for the two-wire system for either voltage. To those who have been using motors at 220 volts electromotive force, and contemplate putting in isolated plants, the great advantage of a machine of this type will be seen when it is understood that motors can be run at 220 volts and lighting for the rest of the building at 110 volts. This dynamo is practically two machines in one. To those who are engaged in building steamships, locomotives and general iron-working industries, where electrical cranes and portable electric drills are used, a machine of this description is valuable, for the reason that a current of electricity can be carried to a great distance for power purposes on economical sized wire, while the remainder of the machine can be used for lighting purposes. This will also apply to business blocks, where electrical elevators, pumps, electric ventilating fans and small machinery are used, as it is a measure of economy to run this class of machinery at the higher voltage. This type of generator is built in sizes of from 10 to 100 horse power, and generators of larger size can be supplied at short notice.

In large cities, where floor space is valuable, it is obvious that where one machine is put in to do the work of two, the expense is greatly decreased; there is one foundation dispensed with, one belt and one clutch pulley, as well as the actual floor space saved. In the ordinary system of lighting and power service, where two voltages are desired, it has always been necessary to couple two machines in series, thus making the first cost of the plant extremely high. While the cost of a dynamo of this description is slightl

higher than a single voltage dynamo, it is low when compared with the cost of two machines. Current from this machine can be taken in any quantity desirable. For example, in a 100 horse power generator the current can be taken at 110 volts or at 220, while any intermediate number of horse power from zero to full load can be taken at either voltage or both at the same time. The company guarantees all machines to regulate within two volts from zero to full load with brushes practically at a fixed point of commutation.

Particular attention has been given to the mechanical construction of this machine, insuring long life, as the bearings are long and large in diameter. The field windings are of high resistance, while the armature windings are of low resistance, insuring long life, from the fact that heating is almost entirely avoided. All machines are guaranteed both mechanically and electrically for the period of two years from the time they are put in service, and any defect that may develop that is traceable to faulty construction will be made good at the company's expense. The bearings are self-oiling and self-aligning, insuring perfect lubrication.

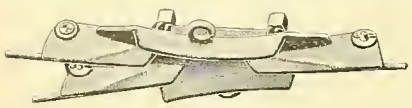


FIG. 1.

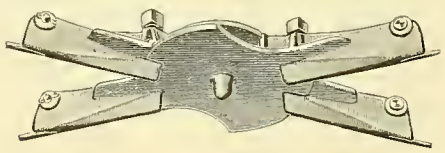


FIG. 2.

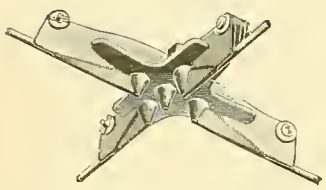


FIG. 3

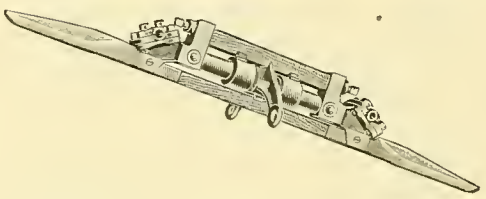


FIG. 4.

ANDERSON TROLLEY DEVICES.

## Improved Engine Indicator.

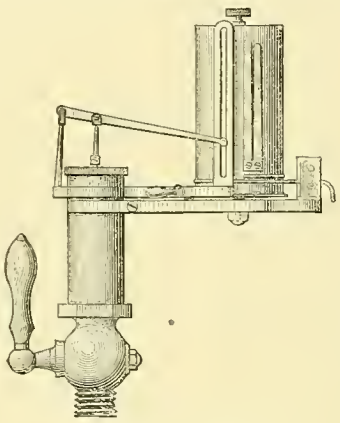
During the last few years the steam engine indicator has arrived at a state of perfection beyond which it seems impossible for it to go. While this is unquestionably the result for which every manufacturer is striving, yet there are cases in which this extreme accuracy, attained as it is by such delicacy of construction, serves as a drawback to the use of the instrument. For instance, there is a hesitancy in applying a first-class instrument to a new engine, or one having recently undergone repairs or changes in the steam piping, on account of the danger of cutting the piston and cylinder by the loosened sand and scale. At such times the question of power is usually not considered and consequently an instrument such as the valve setter will be found to answer the requirements just as well as a better indicator, and can be used with the assurance that if any part is damaged it can be replaced at a merely nominal cost. By an examination of the accompanying cut the construction of the Perfection indicator can be readily understood. The parallel motion is the well-known slot and roller device, and this is considered sufficiently free from friction to be suitable for an instrument of this class, and it has the advantage of being easily kept in repair. By loosening the small screw shown in the carrying arm, the cock can be screwed in place without rotating the entire instrument, and when in the proper position can be firmly fastened. The drum is very light, and the spring can be adjusted for any speed. As the valve setter is not intended to measure power, the springs are not calibrated, but are stamped with the number of pounds initial pressure they are suitable for. This indicator is sold by the Hine & Robertson company, New York.

## Anderson Trolley Devices.

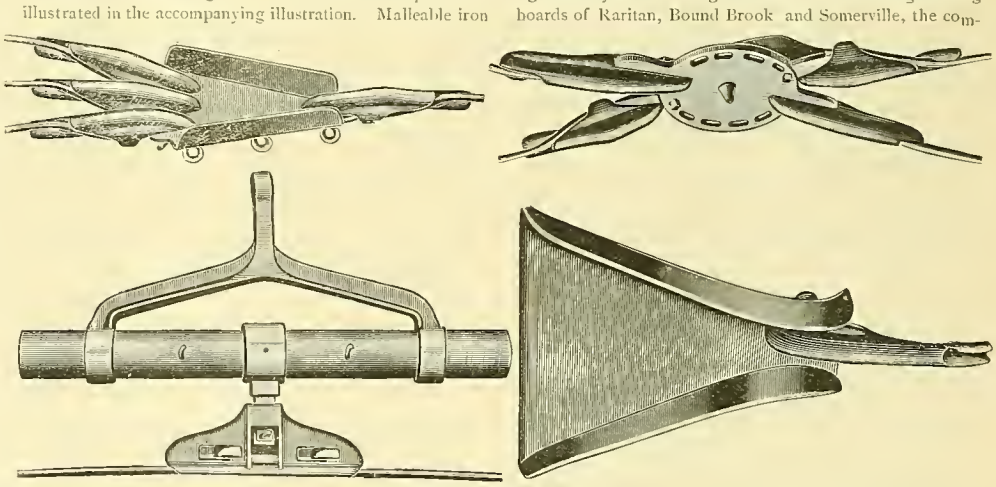
The accompanying illustrations show the new straight underrunning trolley frogs and crossings and section insulators of the firm of Albert & J. M. Anderson, Boston. Every engineer who is familiar with the construction and operation of the trolley system knows the value of a practical, straight underrunning frog and crossing to avoid the dipping and consequent sparking of the trolley wheel in passing under them, as well as the tendency to jump the wire at these places. It is an easy matter to make a frog that is straight underrunning before it is subjected to the strain of the trolley wire, but by a careful investigation of the needs in this direction and a number of experiments, this firm has devised a construction, Figs. 1, 2 and 3, that is strong, and will not, it is claimed, buckle under the line tension, but will remain flush underrunning. It is not heavy or clumsy, and is so constructed that no soldering is necessary. A prominent engineer of one of the largest electrical railroads in this country has remarked concerning these frogs and crossings that they are the greatest improvement in trolley line fixtures that he has noted for some time. The new section insulator, Fig. 4, which is also flush underrunning, is made for permanent construction.

## Metropolitan Specialties.

The Metropolitan Electric company, Chicago, is making a specialty of the Badger railway supplies. The advantages which the Badger state has offered to produce a perfect line of overhead material is perhaps the only reason this material is so named. The extensive trolley lines in this state have furnished much experience in line material, and after overcoming the various faults as they developed, a line of material which has proven a success in every detail has been produced. Not only was efficiency, and durability sought after in perfecting this material, but also cheapness, and the company is able through the simplicity of its design to offer this material at very low figures. The absence of solder in applying this material is also one of the features to recommend it. The material and workmanship is of the highest order, and special care is taken in having all parts of a uniform standard and interchangeable. Several of the parts are illustrated in the accompanying illustration. Malleable iron has not been extensively used for overhead parts, mostly from fear of corrosion. The harder qualities and cheaper prices of malleable iron have induced the company to make a set of switches from this metal, and after they were in use for two years no wear was apparent, while the corrosion was insignificant; and it is from this test that this metal is recommended in preference to brass for these overhead parts.



IMPROVED ENGINE INDICATOR.



METROPOLITAN SPECIALTIES.

The Badger hanger is a simple device for holding the trolley wire to center poles of rigid structures. It is made of malleable iron. The insulation is a piece of maple well soaked in paraffine and P. & B. compound, which allows the trolley wires to move in all directions, avoiding the usual breaks of rigid fastenings. It can also be used for span wire construction. The line of Badger switches shown in the illustration was designed to avoid the trolley jumping in crossing switches at high speeds and to avoid the excessive wear on trolley wheels. To obtain this result the trolley wire is kept on a straight line with the lower edge of the switch arm, and as the wheel leaves the arm the rim of it will run on the pan of the switch without changing its plans. In this way the usual bump in crossing a switch is entirely avoided. There are no bolts or solder required to hold the trolley wire, and the switch consists of but one casting, which is made of malleable iron well japanned.

## A Correction.

In enumerating the results of a test made upon Paranite insulation in the last issue of this journal, a typographical error made the resistance in megohms 25,000. This, of course, should read 2,500.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, October 22.—President H. H. Vreeland of the Metropolitan Traction company announced last Friday that he had commenced the electric road running from Lexington avenue and the Harlem river south. The road will be operated by a wire running in a conduit. An arm projects down from the bottom of the car through the slot and carries a sliding contact on the end, which establishes electrical connection with the wire. President Vreeland says that in the event of this road proving a success four-fifths of street railways in the city will be operated by electricity. Instead of 500 volt current, such as has been in use on the overhead trolley lines, there will be only a standard current of 300 volts, so that there will be no danger to the traveling public.

At a recent meeting of the trustees of the New York-Brooklyn bridge it was voted to advertise for bids for lighting the bridge cars by electricity. Bids had already been submitted by two companies, and C. C. Martin, chief engineer and superintendent of the bridge, recommended that the contract be awarded to the lower bidder, the Electrical & Mechanical Engineering & Trading company of New York. At a previous meeting of the bridge trustees a bid was presented by the General Electric company in which the total was over $3,000 less than that of its competitor; but as the Electrical & Mechanical Engineering & Trading company included placing trolley wires over the entire tracks in the Brooklyn car storage yards, and building the engine and dynamo foundations, Mr. Martin had the former company revise its proposition to conform with these items. Directly connected dynamos and engines will be used.

The New York & Philadelphia Traction company has abandoned for the present the proposed plan of building a trolley road between Somerville, N. J., and New Brunswick. After working for three months in getting signers for the right-of-way and securing franchises from the governing boards of Raritan, Bound Brook and Somerville, the company ran against a snag in the Bridgewater township committee, which has the power to grant franchises outside of towns and boroughs. That committee was willing to grant the company a franchise if it would make the township some recompense, and drew up an ordinance compelling the Traction company to macadamize the whole roadway, which is 30 feet wide, between Somerville and Bound Brook, build and keep in repair all bridges and pay a yearly license of $250. This the Traction company refused to accept.

W. F. O.

## PERSONAL.

Charles Blizard of the Electric Storage Battery company, Philadelphia, was in Chicago last Monday.

P. H. Klein, treasurer and general manager of the General Incandescent Arc Light company of New York, was in Chicago last week.

Henry B. Slater, vice-president and general manager of the Canon City, Colo., Electric Light & Power company, was a recent Chicago visitor.

Secretary and Manager R. Humffreys-Roberts of the Fontaine Crossing & Electrical company, Detroit, Mich., was a visitor in Chicago last week.

Edward Koch has been elected president of the North Chicago Electric Railroad company in place of D. H. Louderback, resigned. Mr. Louderback was also president of the Chicago-North Shore Electric Railroad company, and it was not thought advisable for him to remain president of both corporations.

William H. Hornberger has severed his connection with the Hornberger Electric Manufacturing company of Elkhart, Ind., with which he has been associated for the last five years. Mr. Hornberger was, in fact, the founder of the company, and much of the success of the transformer manufactured by the company is due to his ability.

## ELECTRIC LIGHTING.

Charles Huber has been appointed receiver by the District Court for the Oskaloosa, Iowa, Edison Light & Power & Land compaany. Interest was defaulted on $50,000 bonds for two years. The assets are one electric plant and sixty acres of suburban property.

The Central Electric company, Centralia, Wis., was formed October 1st. Neal Bros. of Grand Rapids, Wis., and the Wisconsin Wood Pulp company of Centralia, Wis., have each put their electric lighting plants in the new company, taking stock for their values.

## ELECTRIC RAILWAYS.

It is said that Berlin is to have an electrically operated elevated railroad. All obstacles, administrative and financial, have now been removed, and a few days ago the sanction of the municipality was granted by an almost unanimous vote.

It is reported that a belt electric railway company extending through Illinois towns within a radius of from twenty-five to fifty miles from St. Louis and nearly the same distance in Missouri is in contemplation. The road will be known as the St. Clair, Madison & St. Louis railway.

The concession for the underground electric railroad for Budapest was granted August 10th, and the company to build it was immediately organized. Its cost is estimated at 9,000,000 francs and its length is a little over 3½ kilometers. A portion of the line is to be finished before the end of 1895 and the whole open for operation by April 1, 1896.

The Chicago City Railway company proposes to continue the Forty-seventh street line—an electric line—eastward to the lake, to construct a line on Lake avenue that shall run northward from Fifty-fifth street to Forty-third street, and ultimately up to Thirty-fifth, thence westward to Cottage Grove avenue. The company already has in circulation among the property owners interested a petition for a right-of-way for the Forty-seventh street extension.

The electric car service in New Orleans, La., was suspended for over a week last month to enable experts to overhaul the plant. An engine rated at 2,000 horse power capacity was found to be furnishing only 400 horse power, and the service of the railway as well as the city lighting suffered correspondingly. One of the causes of the condition of affairs is that the water in the Mississippi river so low that it was impossible to supply the condenser in an adequate manner.

The latest project toward a greater Pittsburg is to be found in a plan to connect Pittsburg and McKeesport by an electric railway. Capitalists of Pittsburg, Baltimore and New York are interested in the new line to connect Pittsburg with McKeesport. There is every probability that the work will be carried through. The project has progressed so far that rights of way and plans and specifications for the construction of the line have all been arranged for. The line will bring McKeesport within shorter distance of Pittsburg than at present. The distance by railroad is 15 2-5 miles, and the proposed electric route will be 10¼ miles, being almost an air line from Pittsburg. The road will connect with the Second avenue line at Glenwood.

The Chicago, Milwaukee & St. Paul Railroad company and the Northern Electric Railway company, Chicago, have locked horns over the possession of a portion of Central avenue, between North avenue and Grand avenue. The Northern Electric Railway company has been constructing its line of tracks along Central avenue, but was obliged to cease operations because of an injunction issued by Judge Tuthill upon complaint of the St. Paul road. The complaining corporation owns several blocks in that vicinity, and Central avenue is one of the intersecting streets, on each side of which the road owns a frontage of 600 feet. It is averred that the electric company is not proceeding by any warrant of the city council or with the con sent of property owners representing one-half the frontage.

An electric railway war is in progress in the coal region of which Pottsville, Pa., is the center, and the scenes of battle are the council chambers of the different towns through which the railways are to travel. There are two rival companies battling for the right of way and franchises from the several town councils. One of these is the Pottsville Traction company, which proposes to build a trolley road from Tamaqua to Pottsville, Minersville, St. Clair Port Carbon, Frackville and Gilberton, making in all 30 miles of electric railway. The Schuylkill Electric Railway company, which is now running a line in Pottsville to Port Carbon and Tumbling Run, has all the best streets in Pottsville occupied, and has been trying for the franchise of the other towns. The Pottsville Traction company has secured the franchises from St. Clair, New Philadelphia and Tamaqua, and has contracted to have its lines finished inside of a year. The representatives of the two companies meet nightly in the meeting rooms of town councils, and fight for the privileges of the several towns.

Delaware, O., will probably become the center of an extensive electric railway system. The county commissioners have granted to a company through a trustee, Colonel J. M. Crawford, a franchise to use the public highways in Delaware county for several electric roads which will bring every portion of the county into speedy communication with the court-house. The franchise contains all restrictions and safeguards and requires completion in three years. The system is a network which can be very advantageously connected with any other lines built toward the county from other points. One line is from Norton to Delaware; one from Delaware south toward Columbus to the Franklin county line; another is to be a branch of this and run to Powell, White Sulphur, Hyattville and thence back to Delaware, making a belt line. A fourth line will run from Delaware through Radnor to the north county line; another from Stratford on the pike leading to Columbus to the county line, also on the Sunbury pike, through Sunbury, thence to the county line; and the last from Inskip's corners on the road leading to Ashley.

## MISCELLANEOUS.

An unusually distressing accident occurred in Boston recently which resulted in the death of two electric light linemen. C. E. Day of the Boston Electric company was cleaning an arc light globe when he in some way received the force of the high potential current. He was strapped to the pole, and when the current entered his body he fell forward upon the arc, breaking the globe. For over twenty minutes he remained upon the cross arm of the post, his arms encircling the carbons while his flesh was being roasted. A. J. Munroe, a lineman sent out by the company, climbed the pole and attempted to cut the wire and he, too, received the current and fell thirty feet to the ground, breaking his skull. At about the same time another lineman some distance from the scene received a sufficient shock from the same wire to knock him to the ground. He, too, fell thirty feet, but landed upon his feet and sustained severe though not fatal injuries. At the power station of the company it was said that the cause of the accident was not known. It was not customary for the power to be turned on at the time of day that the accident occurred. It was admitted that the company had sent out instructions to all its linemen to look out. In these instructions the company said that a dead wire was crossed somehow, and that there was danger.

## TRADE NEWS.

The Central Electric company is meeting with much success in the introduction of its new railway devices, and many calls are made for its overhead material.

In the fitting up of the numerous buildings which are being constructed in Chicago and vicinity, the Washington Electric company's annunciators are not being overlooked.

Edwin Harrington, Son & Co., 1527 Pennsylvania avenue, Philadelphia, have issued an interesting pamphlet on the proper method of handling dynamos and other heavy electrical apparatus.

The last price-list issued by the Butler Manufacturing company, 46 and 48 South Clinton street, Chicago, illustrates a complete line of lamp hoods of every description, in addition to many of the other articles manufactured by the company.

Circular and price list No. 20 of the Interior Conduit & Insulation company, New York, is an interesting exponent of some of the latest ideas in iron armored insulating conduit work. A great many valuable ideas may be gained from this book.

The New Jersey Car Spring & Rubber company, Jersey City, N. J., is distributing a very interesting little illustrated book describing the process of collecting and preparing crude rubber for the market, as well as relating the experiences of the author in the heart of Brazil. The New Jersey company makes such attractive advertising a feature of its business.

The data concerning platinum, etc., just issued in book form by Baker & Co., Newark, N. J., is comprehensive in scope and complete in detail. The uses to which platinum may be put are well nigh inexhaustible, but they are carefully explained and illustrated in this book. Platinum is furnished by this firm in sheet and wire, in any size, shape or degree of hardness and for all purposes.

The New York & Ohio company, Warren, O., manufacturer of the Packard lamp, has issued a very neat little book which tells all about the Packard lamps and their history. The Packard transformer, made by the Packard Electric company of the same place, is also treated of in a similar production. Both books are well compiled, and should interest the electrical trade and users of lamps and transformers.

The trade catalogue of electric street railway supplies recently issued by the Wallace Electric company, 307 Dearborn street, Chicago, is a well arranged little book. Particular attention is called to the insulation which the company uses in all of its standard insulators. The Wallace company claims superiority on its overhead material on account of its adaptability to the purpose designed, combined with tensile strength and lightness, and because of its high insulation. The catalogue is a comprehensive one and contains a large number of illustrations.

A small catalogue of steam specialties has recently been issued by the Hine & Robertson company, 76 Cortlandt street, New York. It is full of just such goods as engineers are so much interested in. There are many pages devoted to four different makes of indicators, reducing wheels, planimeters, etc., while the rest of the book is filled with descriptions of eliminators, separators, heaters, exhaust heads, damper regulators, filters, Eureka and other makes of packing.

The Metropolitan Electric company, Chicago, continues to find a ready market for the Mac tape, which has been giving such satisfactory results. This tape has very high abrasive and insulating qualities, will not oxidize the wire and will maintain its adhesive qualities under all climatic changes. It is put up in ¾ inch widths in ½ pound packages. Special widths will be furnished to order. The Metropolitan company is also meeting with much success with the Gilliland telephone outfits, which are being introduced widely. The company, however, is not the sole selling agent, as has been announced.

General Manager and Assistant Secretary H. J. Hanford of the Harrison International Telephone company has reason to feel proud of the gratifying success which has attended his efforts to thoroughly introduce the Harrison telephone to the public. The company, mainly through Mr. Hanford's persistent application and business ability, has built up a splendid business in the West, and at the present time has a number of exchanges in process of installation. The Harrison company has twelve construction companies working in different parts of the country, and is prepared to build, equip and put in satisfactory running order an entire exchange system, complete in all its details, in any city or town in the United States in the shortest possible time. It has issued a comprehensive illustrated book which describes the telephone and the business methods of the company.

## BUSINESS.

The Ohio Storage Battery company, Wade building Cleveland, O., has succeeded to all the rights for the manufacture and sale of the Ford-Washburn storage battery by sole license from the Ford-Washburn Storelecto company.

Large & Twining, manufacturers of electrical supplies, 321 Chestnut street, Philadelphia, are calling the attention of their friends to the fact that they are now fully equipped with every facility and device for the manufacture of their products. The firm makes a special feature of high grade switchboards and switches.

C. B. Case, Milwaukee, Wis., is agent for the Otto, White & Middleton, Foos and other gas engines, and is also state agent for the chloride accumulator. The growing tendency for gas engine and storage battery plants in this country has been repeatedly emphasized in the columns of this journal, and Mr. Case certainly represents standard articles in their respective lines.

The largest line of pattern letters to put on patterns for castings is made by H. W. Knight & Son, Seneca Falls, N. Y. They are constantly adding new styles and sizes and are abreast of the times in variety and prices. They have recently made shipments to Turkey and have an increasing trade in other foreign countries as well as in the United States. Try them with your next order, addressing Drawer 1256.

The American Electrical Heater company, 45 State street, Detroit, Mich., is introducing an electric soldering iron throughout the country which is deserving of attention. It has been endorsed by prominent concerns in the electrical business, and has given excellent results where used. It is manufactured by the American company under the Tinnerholm patents, and has been in practical service in the works of the General Electric company at Schenectady for more than a year. The Metropolitan Electric company, Chicago, is the western selling agent for this specialty.

George N. Crawford, the Chicago representative of the Watertown Steam Engine company, has just secured an order from the Louisville, New Albany & Chicago Railroad company for one 100 horse power high speed automatic engine. Within the last few days the factory has also received from the same territory orders for a 100 horse power high speed engine from an electric light and power company of Grand Island, Neb., a 50 horse power directly connected high speed engine for the Western Electric company of St. Louis, and a 150 horse power high speed engine for Jacksonville, Ill.

The American Electrical Works of Providence, R. I., although having had a large business during the year, notice a decided increase in trade from the West. Their large works at Phillipsdale present a busy scene, indicating that the new location is none too extensive to meet their rapidly growing business. To reach the American Electrical Works from Providence it is only necessary to telephone that a visitor is waiting at the terminal of the cable road, and their naphtha launch Frolic is sent to convey one up the river to the works. From April 1st to October 1st some 4,000 visitors rode on the Frolic. Evidently the trip is a popular one.

Contracts are being negotiated for an electric lighting plant for two 50 kilowatt directly connected and one 30 kilowatt belt-driven generator of Western Electric company manufacture, two 80 horse power Ideal engines and one 60 horse power Allis-Corliss engine for the Scotten Tobacco factory of Detroit. John Scott & Co., architects, received the bids. Specifications for the plant were prepared by Field & Hinchman, engineers, Detroit, Mich., who will also superintend the entire installation of machinery and wiring. These engineers are now located in their new office at 39 Clifford street. They make a specialty of specifications and tests of electric plants, but are prepared to do a general engineering business. The Scotten plant is the largest isolated incandescent plant yet contracted for in Detroit, and one of the first to use horizontal high speed engines with directly connected generators.

The General Electric company announces a new line of station switches to meet the demand for a reliable switch which, sold at a low price, will nevertheless be as durable and effective in its work as the higher priced goods. The switch is known as the Coper snap knife switch and differs from the generality of station switches in that the contacts and lugs instead of being of cast metal are of pure copper stampings, the contacts having ample contact surface to avoid heating and consequent loss. The hinges of the blades which move in the back contacts are so designed as to give excellent conductivity. The handle and cross bar are connected to the blades by strong spiral springs which pull the blade out, with a quick break action, only after the spring is in considerable tension. Thus the danger of arcing is reduced to a minimun. The switches are mounted on bases of hard white porcelain made by the General Electric company at its works at Schenectady, and are constructed in sizes from 75 amperes to 300 amperes, double and triple pole, with and without fuse holders.

The Moore Electrical company was incorporated under the laws of New York state recently. The directors are Leopold Wallach, the prominent counsel, Joseph Livingstone, banker, Edward J. Wessels, general manager of the Genett Air Brake company, and D. McFarlane Moore, the inventor. Neither Mr. Wessels nor Mr. Moore needs an introduction to the electrical fraternity, as their work is well known. Mr. Moore's claims concerning current control and phosphorescent light have been made widely known since the time when he read his paper before the American Institute of Electrical Engineers on "A New Method of Current Control." For the last five years Mr. Moore has been an engineer for the Edison, Thomson-Houston and General Electric companies. On October 1st he tendered his resignation, and is now devoting his entire energies to developing the business of the Moore Electrical company. The new company has secured all the patents owned jointly by Messrs. Wessels and Moore, and an excellent laboratory has been placed at Mr. Moore's disposal.

The Electric Appliance company, Chicago, is at present distributing two little catalogues which will undoubtedly prove to be of very great interest to the electrical trade, as they are the first separate catalogues published covering the goods which they list. One is a complete catalogue of the Packard transformer, illustrating and describing the process of manufacture and the detail of construction and giving data in regard to efficiency, regulation, etc. This is the first complete catalogue of the Packard transformer that has been issued. The other catalogue covers the complete line of Packard lamps, from the "Baby" to the "Mogul," with special appliances that have been designed by the Packard company and manufactured solely by it for use in connection with its Mogul and other special lamps. This catalogue lists for the first time the Packard theater lamp, a special lamp for foot, border and bunch lights, the Packard stereopticon lamp (a substitute for calciums for theatrical work) and the focusing outfit for use in connection with it. Both of these catalogues are filled with information that will be entirely new to the majority of the trade. The Electric Appliance company would be glad to receive applications from any who have not received copies of these interesting lists.

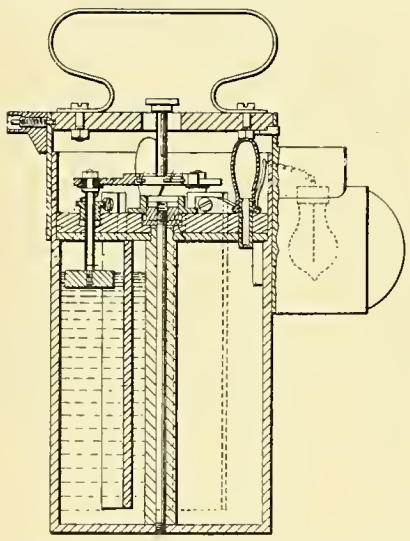
An important point in making or refilling commutators is the necessity of applying heat during the process of building, and from long experience the following method is said by the Mica Insulator company, 218 Water street, New York, to give perfect satisfaction, and be a cure for such ills as loose bars, cement oozing out, or oil soaking in, if micanite segments or rings are used: After assembling the commutator, heat it to about 200° F., or just enough to make the micanite pliable; then tighten the bars or rings as much as possible. The pliability of the micanite will allow the distribution of unequal strains and will counteract to a great extent irregularities in the dimensions of other parts of the commutator. Then continue the heating, but this time let it reach 400° F., or until the shellac, which will have oozed out here and there, has become dry. In fact the shellac may be partially carbonized with no bad results. Then retighten the commutator either hot or cold, but preferably in both states. Do not tighten during the progress of this second heating, but wait until the shellac is baked dry. When no proper arrangements are provided for heating, the commutator can be put for a few minutes inside a boiler furnace door, or on a gasoline stove, or on a plate placed over a blacksmith's forge.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued October 16, 1894.*

527,414. Electric Cable. Thomas J. Dewees, Palmyra, N. J. Application filed June 20, 1894.

In carrying out this invention the inventor employs a cable made up of a series of wires, so as to be flexible, and in which the wires composing the cable may be bare wires, resting one in contact with the other, or formed of insulated wires, in which each insulated wire may convey a separate current. The cables may be made in the form of a rope, or otherwise have the wires bunched together so as to form a practical and flexible structure. The conductors so formed are inclosed in an insulating wrapping of paper or other fibrous material forming more or less air spaces throughout the cable, and exterior to the insulating wrapping is an outer casing of metal to shield the inner structure and make it waterproof. The inventor also prefers to arrange within the outer metallic casing or tubing



NO. 527,436.

and exterior to the paper a moisture absorbent such as powdered quick-lime or chloride of calcium. It is desirable to leave more or less air space which is thoroughly dried by this moisture absorbent, though in practice considerable of the quick lime may get within the fibrous or paper insulation or sheath during the process of construction. The object is to secure as far as practicable a good dry air space about or in contact with the wires forming the cable conductor.

527,415. Dynamo-electric Machine. Ezra Faucett, Alliance, O. Application filed February 15, 1894.

The object of the invention is to provide an improved connection between the cores or field pieces and the pole pieces of electro-magnets for dynamos and electric motors, whereby a perfect connection is made and the greatest possible contact secured between the parts, with extreme simplicity of construction and ease of assembling the parts of such machines

527,436. Primary Battery and Portable Electric Lamp. Samuel W. Maquay, London, Eng. Application filed January 4, 1894.

The inventor employs what may be termed horizontally arranged zinc plates, or plates so arranged that their width is greater than their depth, such as disks of metal used on the flat. This and other improvements forming part of the invention are illustrated in the accompanying drawing, which shows an improved portable lamp from the cells of which the zinc plates may be removed when not in use, and which is liquid-tight. The figure is a sectional elevation showing the improvements applied to a combined portable battery and lamp such as would be applicable for miners' use.

527,461. Apparatus for Signaling the Approach of Street Cars. Garland B. St. John, Kalamazoo, Mich. Application filed November 27, 1893.

The combination is described of a vertical insulated wire, a horizontal wire attached thereto, one end of which wire crosses the path of the trolley pole, the opposite end projecting between the vertical ends of other wires, and these wires connected to groups of signals in opposite directions, the horizontal wire being adapted to be swung by the passing trolley pole into contact with the vertical wire when moving in one direction, and the vertical end of the other wire when moving in the opposite direction to convey signals of the approach of a car.

527,481. Treadle for Use in Railway Signaling. John G. Dixon, Birkby, England. Application filed February 20, 1894.

The invention consists of the combination with a depressible treadle and a counterbalanced and pivoted lever of a dash-pot cylinder, a piston sliding therein, a rod operatively connecting the lever and piston, the insulated contact piece normally above the piston in the cylinder, and the two conductors connected respectively to the contact piece and cylinder, the circuit being completed by the ascending piston.

527,501. Multiple Safety Cut-out. James F. McLaughlin, Philadelphia, Pa. Application filed January 18, 1890.

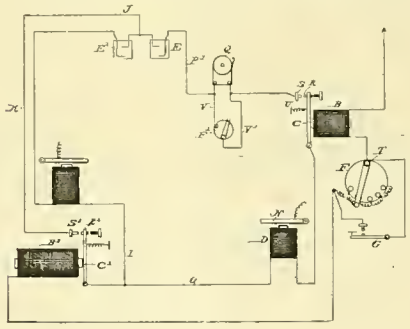
It is the object of the present improvements to render the operation of a multiple safety-plug or out-out patented by the present inventor entirely automatic until all the strips have been destroyed, so that no attention is required in order to again complete the circuit each time it is broken by the melting of a fusible strip on the passage of an abnormal current. In the present instance an automatic operation is effected by putting a switch-arm spindle under the tension of a coiled spring, and maintaining it in position by a detent of peculiar construction, so arranged that the arm will be released when the circuit is broken by the melting of a fusible strip, and will be automatically caught and held when the circuit is again completed.

527,518. Secret Telegraphy. Alfred D. P. Weaver, Jackson, Miss. Application filed December 26, 1893.

The device patented is illustrated in the accompanying drawing. The object of the invention is to enable telegraphic dispatches to be exchanged between such stations as are equipped with the device, the telegraphic dispatches not being heard at stations not equipped with it. Assuming that the instrument has been properly introduced into the loop of the main line, and the rheostat adjusted to the distance between the points of communication, and secret communication is desired between these points, the first operator calls the other by depressing key *G*. This opens a shunt and throws the current through the rheostat, causing the secret relay *B* to exercise less attraction on armature *C*, and the spring *U* being adjusted to pull it back when the relay is thus weakened in energy, contact is made between *K* and *S*, and the bell *Q* is sounded by the following circuit, *F''*, *Q*, *S*, *K*, *C*, *D*, *O*, *C'*, *K'*, *S'*, *K* and *F*; *S'* and *K'* being held closed by relay *B'*, whose main line current is not broken, but only diminished by the rheostat. The result is that the second operator responds to the call, and both operators then adjust their switches *F*, so as to cut out their bells. The opening and closing of key *G* now continues to actuate relay *B* and alternately opens and closes contact points *S* and *K*, and operates the sounder *D* over the following, circuit *C*, *D*, *O*, *C'*, *K'*, *S'*, *K*, *F*, *E*, *P*, *V*, *V'*, being the same circuit last traced except that the bells are cut out.

527,528. Electric Clock. Carl Gullberg, Jersey City, N. J. Application filed September 16, 1893.

The invention consists of improved apparatus of circuit-closing and breaking mechanism for periodically energizing an electro-magnet by which the impulses are given to the pendulum of a clock through the armature carried thereon.



NO. 527,518.

527,546. Trolley. William H. Bache, Bound Brook, N. J. Application filed October 31, 1893.

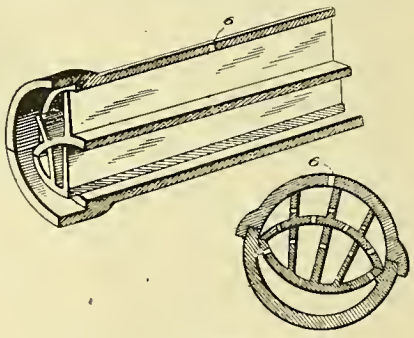
The invention consists in part of the combination in a trolley of a socketed support and a bracket consisting of two sections branched to support the trolley wheel between them, and having arms or projections, together constituting a split pintle adapted to the socket of the support.

527,556. Weather Protecting Covering for Electrical Conductors. Edwin J. Houston, Philadelphia, Pa. Application filed November 17, 1891.

The invention consists in coating the otherwise bare copper surface of a wire with a thin adhesive layer of graphite or other form or carbon analogous to graphite in the particulars desirable for the purposes of the invention and in combining with a wire thus protected, a similarly protected contact roller or other analogous contact device.

527,559. Electric Arc Lamp. Alfred H. Moses, Jr., St. Louis, Mo. Application filed January 21, 1893.

There is described in an electric arc lamp the combination with an inclosure for the carbons or electrodes, this inclosure comprising a casing and a globe section, of a flange formed upon the casing section, a corresponding flange formed upon the globe section and adapted for contact with the casing flange, the casing having the flat under side as shown, pendants projecting from the casing flange, and adjusting screws carried by the pendants, having an upward inward inclination adapted for impinging obliquely on the flat under side of the globe flange at a distance from the body of the globe, adapted to avoid material inward pressure at the angle between the flange and the body, whereby the screws have a direct lifting action and wide range of adjustment, and are capable of exerting strong pressure upon the globe without injury thereto, and of insuring a tight joint between the globe and the casing sections.



NO. 527,597.

527,597. Underground Conduit. Joseph E. Edwards, Toronto, O. Application filed June 7, 1894.

The invention may be readily understood by reference to the accompanying illustrations. The figure on the left is a sectional perspective view of a conduit embodying the invention, and the figure on the right is a transverse section.

527,601. Conduit Electric Railway. Oliver B. Finn, Philadelphia, Pa. Application filed March 16, 1894.

The invention consists of an electric railway system comprising a shoe which is connected with a car, so as to travel therewith, a movable stem with a roller which may be engaged by the shoe, an arm with which the stem may contact, and a feed wire carrying the arm, whereby a circuit may be formed and communicated from the wire to the motor of the car.

527,608. Light Indicator. Louis F. Johnson, Poughkeepsie, N. Y. Application filed April 7, 1894.

The invention consists in the combination and arrangement of parts by which a circuit which is normally closed is broken by the extinguishment of a light, and at the same time another path is offered for the current. Under this arrangement the breaking of the circuit, either by the extinguishment of the light or from any other cause, is made to give both a visual and an audible alarm, whereby the possibility of accidents is reduced to a minimum.

527,730. Rheostat. Alton J. Shaw, Muskegon, Mich. Application filed March 15, 1894.

The invention consists in a resistance card, block or device, formed of a considerable length of metallic band, tape or ribbon, folded back and forth, the folds being separated by non-conducting spacing blocks, whereby free circulation of air is permitted and undue heating is prevented.

527,759. Telephone Call Register. William T. Gentry, Atlanta, Ga. Application filed April 20, 1894.

The operation of the device patented is as follows: The subscriber connects with a call wire, or otherwise calls for the desired connection, and is told by the operator to insert and turn his key. He inserts the key, and by means thereof produces one revolution of a tumbler, registering one thereby, after which he withdraws his key. As the key is turned the bell is rung and heard by the operator at the central office, who knows that he has registered that conversation. If desired, the operator may first call the subscriber to whom the first named subscriber wishes to speak before directing the insertion of the key.

# Western Electrician.

EVERY SATURDAY.

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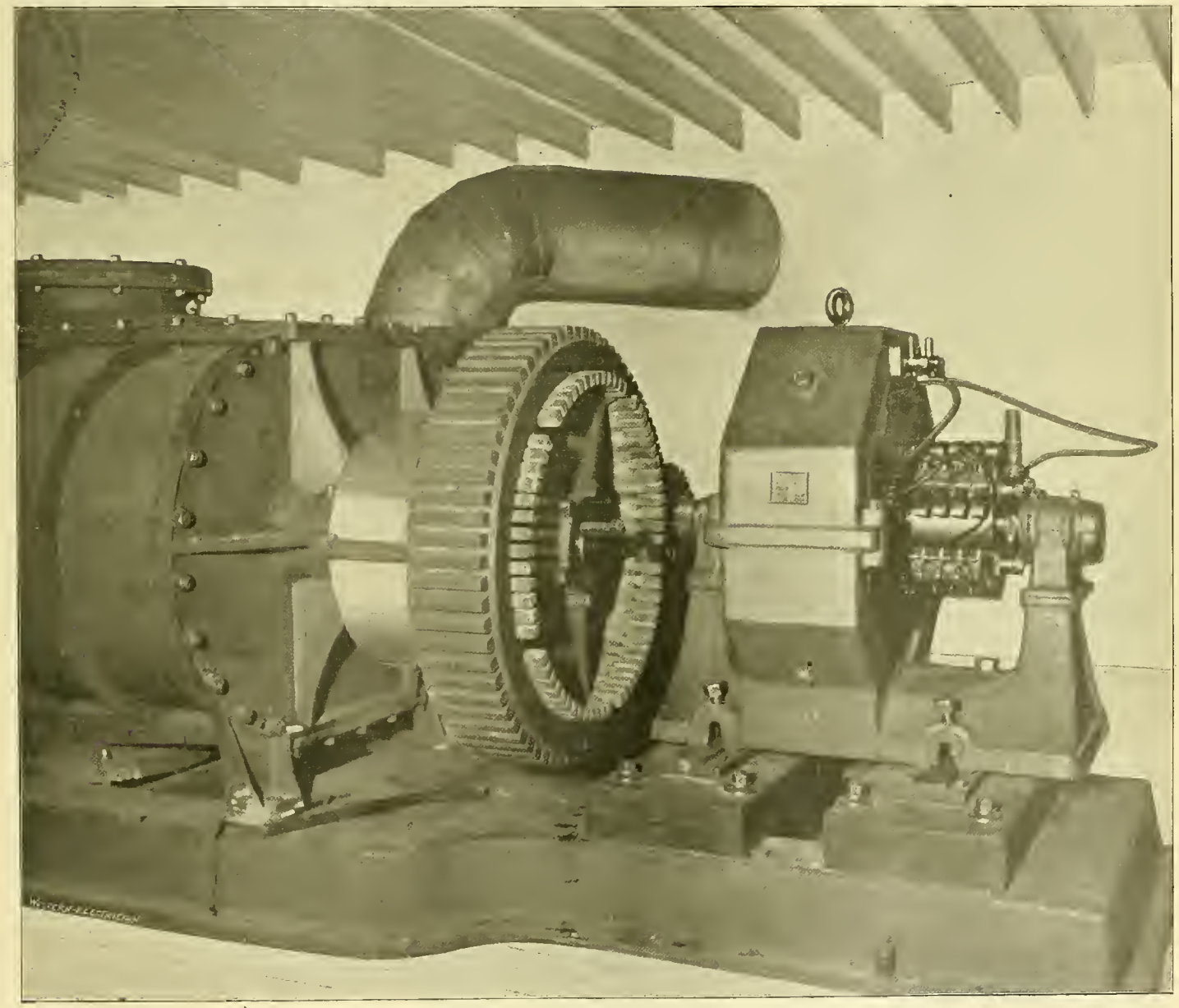
## Directly Coupled Motor and Blower.

The accompanying illustration shows an electrical installation which is of particular interest, as it represents one of the first of a new type of motor of its size and because the motor is geared directly to a large blower, a practice not at all common. The apparatus is in the basement of Marshall Field's establishment and has only lately been installed. The blower is designed to run the pneumatic cash tube system which was installed by the Bosted Package & Cash Carrier company of Chicago. The pneumatic system for conveying cash in stores is meeting with considerable favor, and many of the large retail establishments in the United States are now using it. The Root blower, manufactured by the P. H. & F. M. Root company, is used extensively in this connection for the purpose of producing a partial vacuum in the tubes. The blower illustrated is of the positive pressure type and runs under ¾ of a pound vacuum, exhausting 6,500 cubic feet per minute from 65 different stations. The whole outfit, including blower, bed-plate and motor, weighs approximately 27,000 pounds.

It was especially desirable that there should be as little noise as possible in the operation of the outfit, and to overcome this difficulty a built-up mortise gear of wooden teeth has been used to deaden sound. The blower is designed to run 100 revolutions per minute and is connected with the motor, as seen, by the mortise gear and a cast-iron pinion. The pinion runs at 450 revolutions per minute and the mortise gear 150 revolutions.

The motor was furnished by the Western Electric company and is of its new multipolar form. The speed is approximately 450 revolutions a minute, at which it is designed to give 52 horse power. The commercial efficiency at full load is approximately 89 per cent. and the electrical efficiency at full load is approximately 93.7 per cent. Its weight is 6,800 pounds, and it runs upon a 110 volt circuit. The blower was installed through Edward Harman, manager of the Chicago office of the Root company.



DIRECTLY COUPLED MOTOR AND BLOWER.

## West Side Electric Railway Extension, Chicago.

Under the active supervision of Construction Superintendent Chapman the work of transforming the horse car lines of the West Chicago Street Railroad company into electric roads is now well under way. The power house, at the southwestern corner of Washington boulevard and Western avenue, will be a handsome and substantial structure, faced with pressed brick and cut stone. It will have steel floors. The boiler plant will consist of 20 Stirling water tube boilers of about 400 horse power each, built especially to suit the requirements of the street railroad company's service. There will ultimately be six 2,000 horse power cross-compound non-condensing Corliss engines. At present the company has contracted for three 2,000 horse power engines and one of 1,000 horse power, which are being built by Fraser & Chalmers of Chicago. The generators will be furnished by the Siemens & Halske company of Chicago and will be directly coupled to the engines. The armature spiders of these great machines have just been cast at the factory. The plant will be furnished complete with all pumps, indicators, oiling system, heaters, etc., by Fraser & Chalmers. Two overhead traveling cranes will be built spanning the entire engine room. The boiler stack will be 16 feet in diameter and 240 feet high, 48 feet square at the base where the foundation commences, while the brickwork proper will be about 27 feet square. It will contain over a

million brick and will be one of the largest stacks in the city. The plant is expected to be ready for operation by February 1, 1895.

## Water Power Lighting and Power Plant of Buchanan, Mich.

Eighty-eight miles from Chicago on the line of the Michigan Central railroad, at the city of Buchanan, Mich., is one of the finest water powers in the central states. The Buchanan Power & Electric company has, during the last two years, acquired the water rights and necessary land to build a dam across the St. Joseph river, which will furnish the company with about 3,000 minimum horse power at low water. During the summer months the average flow is 12 inches over a stone dam 400 feet in length.

A power house has been built on the north side of the river, a view of which is shown in Fig. 1, where, at the present time, a finely equipped plant for electric lighting and power has been in operation for the last eight or nine months, furnishing arc lighting for the streets and stores, alternating current for residences and commercial lighting, and a power circuit for driving the pumps at the city water works and furnishing current for motors in factories and small shops. The power at present is derived from three 100 horse power turbines of vertical type geared by quarter gearing to a 75 foot line shaft, Fig. 2, extending from the wheel pits through the entire length of the main dynamo room. The arrangement is such that either or all of the wheels may be used at the same time on the main shaft. Within the dynamo room the shaft is provided with driving pulleys on quills which are governed by friction clutches.

The present electrical equipment of the plant was furnished by the Standard Electric company of Chicago and consists of one 60 light Standard arc dynamo operating at 900 revolutions a minute, which furnishes current for the street lamps and commercial arc lights; a 45 kilowatt, 550 volt compound wound multipolar power generator running at 675 revolutions a minute, which furnishes current for the power circuit, to which is attached motors for driving the pumps in the city water works, as well as various smaller motors scattered about the town; also a Standard 1,250 light alternator, with a self-contained exciter furnishing 1,100 volts on the primary circuit, with a full equipment of arc lamps, converters, etc. The switchboard, shown in Fig. 3—a view of the dynamo room—is finely equipped with Standard instruments and accessories. The arc lamps used are of the Standard double service, weatherproof pattern. On the opposite side of the river the company is now putting in additional wheels for about 800 horse power capacity, which will be used in the development of power for factory purposes. Some two or three large factories have already been secured, which will employ altogether some 200 or 300 hands. Arrangements are being concluded for the location at Buchanan of a number of smaller factories, which will be built at most advantageous points for shipping and use electric motors for power.

The generating machines used in this installation are of the well-known Standard type, and the arc machine is of the same pattern as that which showed by test at the California Midwinter International Exposition an efficiency of 87.85 per cent., including transmission. The pole pieces, which form the main portion of the frame, are of special cast iron, and the field magnet cores employed are of wrought iron. These pole pieces, with their cores, which contain the magnetic circuits of the apparatus, are insulated from the base by a distance piece of brass or zinc, thus reducing the magneticleakage to a minimum and giving a uniformity of lap to the brushes on either side of the commutator. The range of the brushes from the neutral point between the sparking point on either side causes a variation of nearly one ampere. The total change of load leaving the brushes standing at the non-sparking point does not exceed one-quarter ampere. The switching device on the terminal board permits the full load of the machine to be thrown on or off without any unnecessary sparking or kindred trouble at the commutator or brushes. The switch first short-circuits the fields, cutting them out of the external circuit, and then short-circuits the armature on its own terminals. By removing the pedestal at either end of the shaft, the armature may be taken out or replaced, or the same result may be accomplished by taking off the upper pole piece and raising the armature from its position in this manner.

Three circuits, one for arc and one for incandescent lighting and one for power purposes, are led from the station on a pole line to a distributing point in Buchanan. The entire plant has been giving excellent satisfaction and presents a fine example of an electric plant operated by water power.

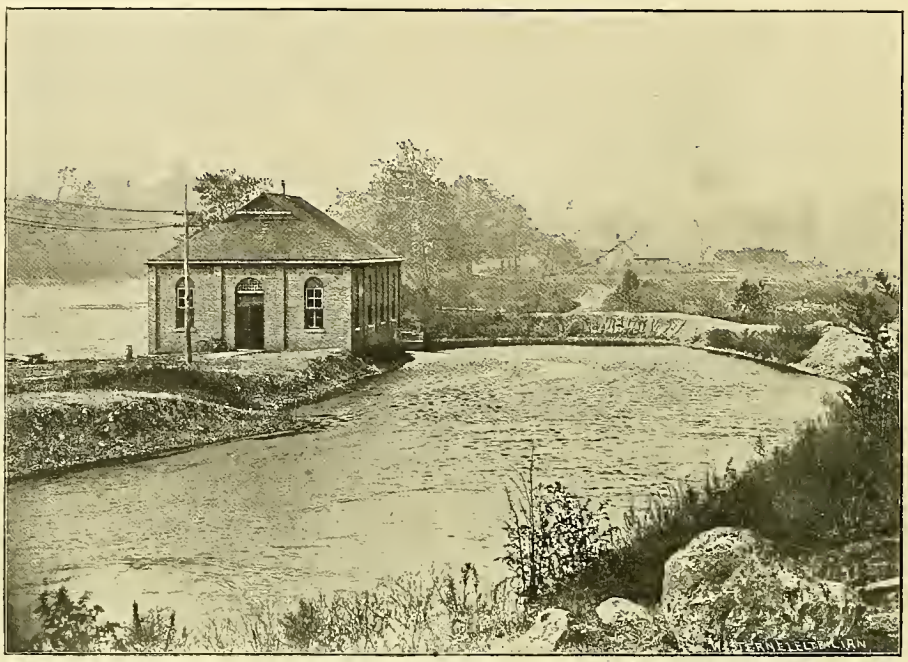


FIG. 1. WATER POWER LIGHTING AND POWER PLANT OF BUCHANAN, MICH.

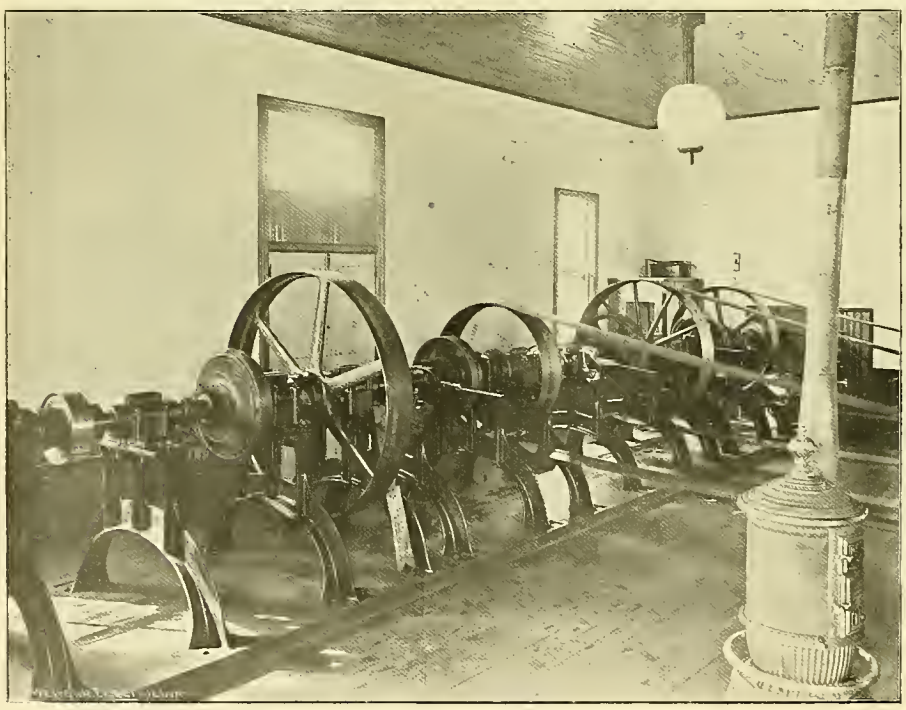


FIG. 2. WATER POWER LIGHTING AND POWER PLANT OF BUCHANAN, MICH.

## Electric Railways in the South.

In an interesting article on the development of the electric railway in the South the *Manufacturers' Record* presents some valuable statistics that will appeal most forcibly to railway men at this time. An abstract follows:

This convention of street railway men is peculiarly fitted to be held in a southern city this year, as the development of electric railways in the states south of the Susquehanna river has been especially rapid and extensive within the last few years. When one investigates the amount of work done the figures reach astonishing proportions, and show beyond a doubt that this part of the country has not only kept up with but perhaps has gone beyond others in the building of electric lines. As to the amount of rapid railroad building which the South has accomplished within a few years, the city of Baltimore furnishes a most notable illustration. Three years ago every one of its street car lines was operated by horse power, with the exception of one mile of electric road in the northern part of the city. At present horses are used on but one road in the city limits, and by 1895 this will be rebuilt for electric operation. Since the date mentioned about 220 miles of track have been laid in and near the city for cable and electric motive power, on which about 600 electric or cable cars are operated, and which require the power generated in nine large stations. These figures will give merely an idea of the investment of capital in Baltimore alone in the street railroad business within three years.

But to show how generally southern cities are provided with rapid transit facilities, the following list is appended, all of which have one or more electric lines:

Alexandria, Va.
Anniston, Ala.
Asheville, N. C.
Ashland, Ky.
Athens, Ga.
Atlanta, Ga.
Augusta, Ga.
Austin, Tex.
Baltimore, Md.
Baton Rouge, La.
Birmingham, Ala.
Bristol, Tenn.
Charlotte, N. C.
Chattanooga, Tenn.
Columbus, Ga.
Covington, Ky.
Cumberland, Md.
Dallas, Tex.
Danville, Va.
Denison, Tex. (steam).
Fort Worth, Tex.
Frankfort, Ky.
Gadsden, Ala.
Galveston, Tex.
Hampton, Va.
Hot Springs, Ark.
Huntington, W. Va.
Jacksonville, Fla.
Johnson City, Tenn.
Knoxville, Tenn.
Laredo, Tex.
Lexington, Ky.
Little Rock, Ark.
Longview, Tex.
Louisville, Ky.
Lynchburg, Va.
Macon, Ga.
Martinsburg, W. Va.
Maysville, Ky.
Memphis, Tex.
Mobile, Ala.
Montgomery, Ala.
Nashville, Tenn.
Natchez, Miss.
New Orleans, La.
Paducah, Ky.
Petersburg, Va.
Raleigh, N. C.
Richmond, Va.
Roanoke, Va.
Rome, Ga.
San Antonio, Tex.
Savannah, Ga.
Sherman, Tex.
Shreveport, La.
Tampa, Fla.
Vicksburg, Miss.
Waco, Tex.
Washington, D. C.
Wheeling, W. Va.
Wilmington, N. C.
Winston-Salem, N. C.

This list does not include several cities in which a steam-dummy system is used in place of horses and mules.

In most of these cities the power plants, quality of road-bed and rolling stock will compare favorably with the systems in any of the municipalities in the country. Taking Atlanta for example, not a horse car is to be seen on its thoroughfares. The electric lines connect the business and manufacturing centers, hotels, railroad depots, theaters and churches with the principal residence sections in and beyond the city limits. On the Consolidated lines, which contro

sixty-four miles of track, the rolling stock is from the best makers in the country, such as the Pullman, Brill and Stephenson works, while Corliss engines of the most modern type furnish the generating power. Although Asheville, N. C., has less than 12,000 in its resident population, it has three electric routes in operation, embracing in all fourteen miles. No animal power is used on any of its lines. At Savannah and Augusta, Ga., the motive power is electric. In the former city the rate of fare at present is doubtless the lowest in the world for car service—one to three cents, with transfers to any part of the city. This, however, is owing to competition between rival companies. The equipment in both of these cities is equal to that in Atlanta. Baltimore has already been referred to, but the opinion of expert railway men may be added that the street transportation service in the city today surpasses that of any other in the country in point of cheapness and excellence. The four principal companies—City Passenger, Traction, City & Suburban and Lake Roland Elevated—give free transfers between each of their respective divisions, while the last named company and the Central issue transfers good on either road. The lines of the four companies connect the center of the city with the principal suburbs and parks, and also traverse the sections where the mechanics and laborers reside, giving them excellent facilities for reaching their places of employment. The power house equipments are from the most noted manufacturers; the roadbeds are laid with 60 and 70 pound steel rails on good ties, and it is said to be a fact that every line is constructed substantially enough as to track to be utilized by a steam locomotive were it necessary. As a result very fast time is made, and there is an absence of the jolting and jarring so often noticed on lightly built systems.

Next to Baltimore, the city of New Orleans, La., has been the scene of more electrical construction than any other point in the South. Fully 100 miles of track will be completed by the end of this year. As in Baltimore, animal power was used exclusively in the city up to two years ago, with the exception of one or two sections in the outskirts, on which steam dummies were operated. The New Orleans Traction company, Canal & Claiborne company, New Orleans & Carrollton company, Orleans company and St. Charles Street Railroad company have all let contracts for electric equipment. These corporations combined own 150 miles of road. Two of the companies have lines now operated by motors.

Chattanooga, Tenn., with about 30,000 population, has nearly fifty miles of its railroads operated by electric motors. Few cities of its size are as well provided with electric means of transit. Knoxville, Tenn., with 22,000 people, has nearly one mile of electric road to every 1,000. Nashville and Memphis, in the same state, have sixty-seven and sixty-one miles of electric lines. Richmond, Va., has also an excellent service of this character. Fifty miles of its street railways are operated by the Edison and Westinghouse systems, with open and closed cars, according to the season.

It is also interesting to note how the smaller cities in the South have kept up with the era of rapid transit. In Virginia, Roanoke, Lynchburg, Danville and Petersburg have lines in successful operation, while at Staunton, Charlottesville and elsewhere arrangements are being made to build them. An extensive system is now under construction in Norfolk, and will probably be partly used this year. Beside Asheville, the cities of Winston-Salem, Charlotte, Wilmington and Raleigh, N. C., have electric lines on the principal streets. Charleston, S. C., is about to secure a system. Columbia, the state capital, has one which has proved very successful. Greenville and Spartanburg will doubtless have roads within two years. Besides the Georgia cities already mentioned, Macon has an admirable service. Companies are also established in Columbus, Athens and Rome. Anniston, Montgomery and Gadsden are among the Alabama cities, Natchez in Mississippi, and Baton Rouge in Louisana. While Texas is still in the beginning of its period of settlement and development, electric transit has found, favor in many of the cities; for instance, Austin, Dallas Denison, Fort Worth, Laredo, Longview and Sherman. In Galveston, Houston and San Antonio the systems are very extensive, embracing the main parts of the cities and suburbs. Hot Springs, Ark., has twenty miles of line operated by motors of the Thomson-Houston system.

It has already been intimated that the building of electric railways and other modes of rapid transit in the South has been very extensive within a comparatively recent period. The following table, compiled from the construction department of the *Manufacturers' Record* and other authorities, gives the mileage completed for electric and cable power in cities from January 1, 1893, to September 1, 1894:

| | Miles. |
|---|---|
| Maryland | 185 |
| Virginia | 7½ |
| South Carolina | 4 |
| Georgia | 28½ |
| Florida | 3 |
| Alabama | 31 |
| Louisiana | 93 |
| Texas | 37 |
| Arkansas | 1 |
| Tennessee | 8 |
| Kentucky | 6 |
| District of Columbia | 35 |
| Total | 439 |

Of which 47½ miles are cable lines.

The total mileage of electric lines projected and under construction is appended in the following table:

| | Miles. |
|---|---|
| Maryland | 24 |
| Tennessee | 9 |
| Virginia | 15 |
| South Carolina | 20 |
| Alabama | 7 |
| Georgia | 22 |
| District of Columbia | 29 |
| Total | 126 |

Does not include Washington-Baltimore or Baltimore-Gettysburg proposed lines.

Summing it all up, we find that within two years companies in southern cities have constructed 439 miles of rapid transit routes, and that 126 miles more are being constructed, or will be in a few months. This is truly a remarkable record. To show how rapid has been the progress of southern cities in this direction, another table is given as follows:

| | Miles. |
|---|---|
| Total mileage of electric and cable systems at present completed in the South | 1,485 |
| Mileage completed since January 1, 1893 | 439 |
| Mileage previous to 1893 | 1,044 |
| Total completed and projected | 1,611 |

In other words, the 439 miles of new lines represent nearly 30 per cent. of the entire distance covered by electric and cable companies on the streets of southern cities. With the 126 miles projected and under construction, it is 35 per cent. If anything were needed to prove how rapidly the South is improving in the way of transit, this will suffice.

Anyone will at once acknowledge that the money invested in rapid transit systems in the South will reach into the millions, but the question is how far. The building of roadbeds, heavily ballasted, with the best steel rails, in connection with the poles and wiring necessary for the ordinary trolley system, is a very large item in itself, especially if bridges are required, or cuts or fills are to be made for grading; to this must be added the cost of the power station, with its powerful engine, or set of engines, according to the current to be generated, the dynamo plant and the auxiliary apparatus. Experts estimate that an electric line along an ordinary highway which requires no unusual amount of grading or bridging can be built and equipped ready for operation at about $20,000 to $25,000 per mile. The expense in cities is much greater. On streets which have never been used for railroad purposes before, the figures range from $30,000 to $40,000 per mile, while the cost of rebuilding horse railroads for electric motors, including power and equipment, ranges from $45,000 to $55,000 per mile. By means of these estimates an approximate idea can be gained of the cost of the electric and cable systems in operation to-day in the southern cities, making due allowance for the cost of the cable conduits over electric roads.

FIG. 3. WATER POWER LIGHTING AND POWER PLANT OF BUCHANAN, MICH.

The figures reach a total of $71,080,000, of which nearly $12,000,000 was paid for the construction and equipment of new roads, and $60,000,000 for the converting of horse railroads into rapid-transit lines. Since January 1, 1893, the sum of $21,000,000 has been invested in this manner, while the lines contemplated and under construction involve an expenditure of $6,000,000, making a grand total of nearly $80,000,000 capital placed in this direction alone in the South.

The investment in these southern rapid transit systems has found much favor in the North, and it is safe to say that over 50 per cent. of the mileage has been built by outside capital. A few instances of these investments may be cited. At Baltimore the Elkins-Widener syndicate of Philadelphia controls the Baltimore Traction company's roads. The Lake Roland Elevated system, twenty-two miles long, was the result largely of capital placed through the Jarvis-Conklin Mortgage Trust company of Kansas City. The president and one of the heaviest stockholders of the City & Suburban system is Nelson Perin, originally from the West. Murray Verner, the Pittsburg street railway operator, is building one of the Norfolk electric lines. Boston capitalists hold most of the bonds issued by the Atlanta Consolidated Railway company. The Jarvis-Conklin company practically built Augusta's railway. New York bankers are heavily interested in several of the New Orleans lines being supplied with rapid transit facilities.

These investments, however, are not remarkable when one examines what improved street railroad service has done for the South. It has been the means of building up and developing suburban property which otherwise would have been isolated practically from the city. It has brought residence streets near the corporation limits within a few minutes' ride of the center of the city. As a result houses on these streets have been rented more readily and have commanded a much better price, while the suburban property has rapidly advanced in value. The building of electric lines through sparsely settled portions of a city stimulates people to locate in its vicinity, with the result that a marked improvement in the value of property becomes apparent.

Such are only special advantages. Many others might be enumerated, but these sufficiently explain why men with money have such faith in rapid transit projects. They have doubtless enlisted outside capital in many other enterprises, such as factories, hotels, suburban towns, etc., which would never have been undertaken had not the building of the railway revealed the advantages to be gained by a further expenditure of money.

The application of electricity in various ways is so closely related to rapid transit that a brief outline of what the South is doing in this direction will not be out of place in an article of the present character. People unaware of the progress of this section in public improvements will doubtless be astonished at the figures, but they are compiled from the best authorities and are accurate. As the cars on fully 95 per cent. of the street railroads are operated by electric currents, it becomes apparent that a large number of power houses are required. Some of these stations are used simply for furnishing a motor current, while others furnish currents for motive power and illuminating purposes as well. In the larger cities of the South the lighting plant is usually separate, and constructed only to supply the several circuits of lamps. A careful examination of the apparatus, from the steam engine to the smallest insulator, reveals the fact that many of the southern stations are supplied with the best grades of steam and electrical mechanism and are complete in every detail. The engines range as high as 2,000 horse power, and are of such makes as Allis, Corliss, Hamilton, Cooper, Ball, Westinghouse, Armington-Sims, Ide, Russell, McIntosh & Seymour, Taylor, Ball & Wood and others which are standard. The principal electric systems used are the Thomson-Houston, Westinghouse, General Electric, Fort Wayne, Short and Detroit.

Up to January 1, 1893, the following number of electric power stations for motor and lighting purposes were built in the South by companies whose aggregate capital stock is also given:

| State. | No. Stations. | Capital Stock. |
|---|---|---|
| Georgia | 16 | 1,646,000 |
| Kentucky | 22 | 1,514,000 |
| Arkansas | 19 | 1,261,000 |
| Florida | 15 | 978,000 |
| District of Columbia | 2 | 1,525,000 |
| Louisiana | 7 | 965,000 |
| Alabama | 29 | 1,950,000 |
| Maryland | 19 | 2,443,000 |
| Mississippi | 9 | 345,000 |
| North Carolina | 18 | 619,000 |
| South Carolina | 12 | 469,000 |
| Tennessee | 18 | 592,000 |
| Texas | 55 | 3,776,000 |
| Virginia | 35 | 1,354,000 |
| West Virginia | 18 | 461,000 |
| Total | 296 | 19,891,000 |

Since the time specified the construction department of the *Manufacturers' Record* shows that 166 plants have been completed or are in course of construction. These include the station of the Brush Electric Light company, which replaces one burned, and which is valued at over $1,000,000;

also the station of the Baltimore & Ohio Railroad company, for operating electric locomotives by the trolley system. These plants represent capital stock of fully $15,000,000, making a grand total of 461 stations controlled by companies capitalized at $35,000,000.

This is what the South has done in the adoption of electricity as one of the great factors in its progress, and it is indeed very appropriate that such a convention as that referred to should meet in one of its cities which so strikingly illustrates the benefits of this powerful agent.

## Electric Capstans.

The mechanical applications of electrical energy are gradually assuming marked importance. For several years, says *La Nature*, we have had electrical capstans on the Northern railroad of France, as well as in many manufacturing establishments, and in all cases these have given satisfactory

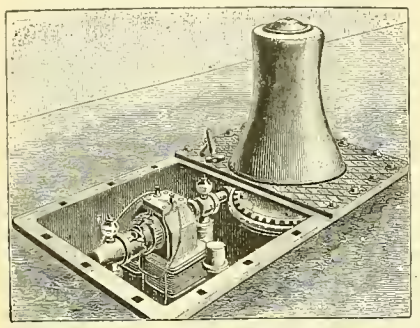


FIG. 1. ELECTRIC CAPSTAN.

results. The capstans constructed by Humpidge & Snoxell of Dudbridge, England, which have been in service since 1891, for moving coal cars, are illustrated herewith. Fig. 1 shows the general arrangement of the apparatus. The motor is inclosed in an iron case, thoroughly protected by the cover, which has been removed for the illustration. The shaft of the motor, as shown, engages directly with the foot of the capstan. The case or shell of the whole machinery is sunk to the level of the surrounding earth. By the removal of the cover access to the motor is easily achieved.

Crompton & Co. of Chelmsford, England, have also placed capstan motors upon the market. These are compound wound and normally consume a current of 45 amperes at 110 volts. This pressure may, however, be much increased without detriment. With the above consumption of current the capstans will each move two cars of ten tons each at a speed of four kilometers per hour. A special arrangement is attached by which the throwing in of the current is gradual, and the motor, by means of a rheostat, is thus started slowly. As shown in the illustrations, a cylinder projects above the plate, and is pressed by the foot of the operator to break the circuit. A new arrangement of connections is shown in Fig. 2. The electric motor is of the same description as to winding and power, and inclosed like the first, but in a more restricted space. The power is transmitted, however, not directly but through a system of spur gearing, as shown.

The use of electrical capstans has introduced an economy in mechanical application far beyond that attained by hydraulic machinery. The electrical energy consumed is in direct proportion to the work done. These practical considerations cannot but aid in popularizing the employment of electrical capstans.

## Views of Presidents of Steam Lines on Electricity in the Railway Field.

In a recent issue of the *Boston Herald* a symposium was presented consisting of letters from presidents of various steam railroad companies in answer to the following questions:

Have the steam railroad companies anything to fear from the competition of local electric lines?

What is the future of electricity as an element in rail transportation?

If your road feels the competition of parallel electric lines what action is contemplated to meet it?

Many of the views given seem to be of the utmost importance from a practical standpoint. Vice-president J. T. Odell of the New York & New England road, has this to say:

Steam railways seriously feel the effects of competing local electric lines. This is particularly true in all but four months of the year, and I doubt whether there is a city in the country of any importance where electric lines are not paralleling suburban steam railways. The steam railways do not, however, feel the effect to the full extent of the earnings of the electric lines, the electric lines themselves creating a business which might eventually compensate the steam railroad for some of its losses. In some instances that I have investigated the loss to the steam railway is not as great as it would be if the rates were reduced to the electric road's rates, and whenever the steam railroads discover that in order to prevent serious loss they must meet the electric rate they generally do it, provided it does not affect the fares beyond the electric lines. In regard to the future of electricity as an element in rail transportation it is difficult to form an opinion. I believe, however, that between two large cities, say where the distance apart is about 40 or 50 miles, it is not improbable that electricity will be used. I doubt if anyone living will see electricity substituted for steam to any greater extent than here indicated.

President O. D. Ashley of the Wabash railroad is quoted in part as follows:

My impression is that steam railways will not be seriously injured by the local electric lines, although at first sight it would appear probable that suburban trains would feel the competition. On the other hand, the local electric lines, radiating in short distances from populous centers, will act as feeders to the steam lines, and while in some instances they may draw passengers from them, in others they contribute to the conveniencies of reaching steam line stations, and may even be considered as branches to the steam line system. I am inclined to believe that, eventually, electricity as a motive power will supersede steam, but I no not think it will become an important factor in general rail transportation for long distances until the method of its application has been greatly changed and improved. It would be idle to deny great possibilities in the future of electricity, and I am a strong believer in its subtle potency as an agent in practical work; but I doubt very much whether man's intelligence has mastered its secrets sufficiently to count upon its constant and economical work for long distances. There are many serious objections to overcome, I think, before it can be considered a formidable rival for general transportation by rail. When these objections are overcome, I believe the steam roads are in the best position to avail of the power, and that they have such an advantage in construction and location that they will be the first to utilize it successfully. It does not appear to me that this condition is yet in sight, but as to this I may be mistaken. I believe electric power to be a giant, still in infancy. Its growth has already been abnormally rapid, but it will require long study and experience to develop its great capacity, and to teach us the best method of controlling and utilizing it.

L. J. Sargeant, general manager of the Grand Trunk, Canada, says:

There is, I think, no doubt that the competition of local electric lines for suburban traffic may become a serious matter for railway companies. They have to purchase costly property, construct embankments and bridges, fencing, over-bridges and subways, to keep an extensive staff at crossings, to reduce speeds, and to do all that is humanly possible to prevent accidents.

On the other hand, the electric lines run over public roads already made, employ none of the expensive surroundings of the railway companies, attain sometimes dangerous speed, and take few adequate precautions against accident—which, in fact, having regard to the circumstances, they cannot do.

With respect to the adaptation of electricity to railway purposes, it is impossible to conjecture to what extent this wonderful agent may be developed, but, so far as its present adaptability is concerned, electricity would be too costly, and could not be adapted to all requirements of the railway service. I found that to be so, when considering the question in connection with the working of a short piece of line between A and B, not long since.

Roswell Miller, president of the Chicago, Milwaukee & St. Paul, says:

It is my opinion that such steam railways companies as do a large suburban businesss will find considerable of that business diverted from them by local electric lines. Our company has felt the competition of electric lines but little. We have never devoted much attention to the development of suburban business, because our situation has not required it. Unless suburban business is very large, I do not think there is much profit in it for steam railways, and therefore we have viewed the extension of electric lines without alarm. In our territory they have thus far only affected suburban business.

## Combination Fixture Litigation.

The Philadelphia *Public Ledger* of October 23d has the following: The Circuit Court of Appeals finally determined the case of George Maitland against Alfred C. Gibson, trading as the Gibson Gas Fixture Works, by affirming, in an opinion by Judge Acheson, the decree of the Circuit Court in dismissing the bill of complaint. In this case the plaintiff claimed that by two letters patent, granted to Luther Stieringer, of whom he was the assignee, for fixtures for electric lights, and for what are called combination fixtures, in which gas and electricity are both used for lighting, he had the monopoly of hanging an electric light on a fixture attached to a gas pipe, whether the fixture was used simply for an electric light or whether it was used for electric light and gas. The patentee did not claim that he made any new style of fixture, but simply adopted the ordinary gas fixture, and by running wires down through the ordinary gas pipe, in a fixture used simply for electric lights, or between the iron pipe and the brass casing where the fixture was used both for gas and electricity, he claimed that he had made an invention. The practical effect of this would have been that the ordinary gas fixture, familiar to everybody, could not have been used for an electric light except by paying Maitland a royalty. The contest which has now been ended would perhaps have been of little public interest apart from the plaintiff's claims, which, upon their face, were preposterous, were it not that the Gas Fixture Trust, by obtaining practical control of the patents, endeavored to use them to coerce gas fixture manufacturers to join the trust. In this they were to a considerable degree successful, but Mr. Gibson, having declined to join the trust, concluded that he would fight the patents. He therefore contested the suit against him, and also fought the Gas Fixture Trust. The trust has gone to pieces, and many of the people or companies who were in it have gone into the hands of the sheriff or into the hands of receivers, and the decision of the Circuit Court of Appeals thus ends what at one time appeared to be one of the greatest monopolies of the present time.

## Use of the Booster on Electric Railway Circuits.[1]

By J. H. Vail and H. S. Wynkoop.

The question of investment in copper is one which has always been a bugbear to the street railway manager, and is to-day the most serious problem confronting the operating company, inasmuch as it tends to restrict the extension of long-distance lines for serving suburban traffic. Since the cost of copper for a given service increases directly as the square of the distance, the necessary investment becomes prohibitory when the line extends more than three or four miles from the station.

Railway generators and motors are becoming more satisfactory; we are still allowed, in the absence of a conduit system inspiring confidence, to suspend our trolley wires overhead; and in some cities the authorities will look the other way while we string cables as large as hawsers from pole to pole, in pairs, in dozens, and, if poles could be found to stand the strain, probably in scores.

Even then we are not happy. The power house site is usually chosen, so far as circumstances will permit, with reference to convenient coal delivery and the distribution of traffic. In the heart of the city crowded streets render slow speed imperative; in the suburbs, where a clear track invites to rapid transit, the pressure is low, usually abominably so. In fact, the writers have in mind a city, not far from the metropolis, where two motor cars are run upon a single car's time; and they have witnessed the fading out of the electric headlights as the two cars started out together. The reduced voltage was in this case self-evident; and the net horse power secured to move the cars was probably less than half the proportionate amount originally generated in the station. The loss in transmission does not require further demonstration.

Accurate tests show that the commercial efficiency of the street railway motor at normal voltage is 78 per cent., while at two-thirds of the normal it is only 52 per cent. We all undoubtedly recognize the fact that the resultant effects of too little copper show up to the non-expert traveling public in slow speed and dimming of lamps; but to the railway company the results are actual losses—decreased traffic and increased coal bill,—which are the direct opposite of what we desire. In other words, instead of aiming at the greatest receipts for the least expenditure, we are actually getting least receipts for greatest expenditure.

The usual remedy suggested is: use more copper. Very good. But if the owners of the road are already groaning under the weight of the copper mine that has been saddled upon them, together with the cash invested therein; if they live in constant fear that they will be forced to place all feed wires in large cities underground (where they should be)—what then?

Leaving out of this discussion improvement in generating station, car equipment and track, we must look for higher economy to the alteration of our methods of electrical distri-

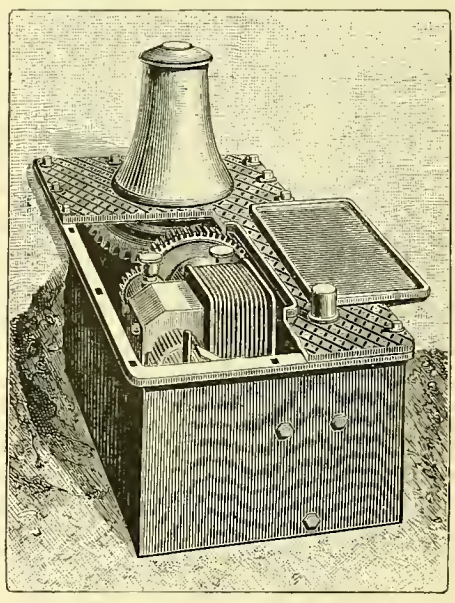


FIG. 2. ELECTRIC CAPSTAN.

bution, adopting such as will prove, after careful comparison, to be of least first cost, of reasonably high commercial efficiency, of interchangeability on different divisions of the system, and of practically automatic action.

We are in need of a marked advance over present practice in this direction, and must devise some method of distribution that shall give better and more economical service over a large area, and which shall at the same time enable us to reach out from the power station to distances at present inaccessible.

The alternating current system, which has done so much to develop the distribution of electricity for lighting by incandescence, has not yet reached that stage of eminent perfection in motive power service which will warrant us in admitting its value for railway work at the present time.

Another method which might be suggested is one which contemplates the use of motor-generators located at intervals

1. Read before the thirteenth annual convention of the American Street Railway association, Atlanta, Ga., October 17-19, 1894.

along the line and actuated by high-tension currents. Such a system must be automatic under all conditions of load and short-circuits, working with cool bearings, and not requiring careful attendance. This scheme also requires practical development.

The well-known booster system, invented by W. S. Barstow and applied by him with great success to the feeders of constant potential electric lighting plants covering large areas, is worthy of our careful investigation, as it promises to offer a practical aid to the economic solution of what may be called the medium long-distance electric railway problem.

With direct feeding we can overcome the loss in transmitting energy only by incurring the heavy cost of copper as a first investment. With the booster system we overcome the loss in transmission by incurring the cost of operation

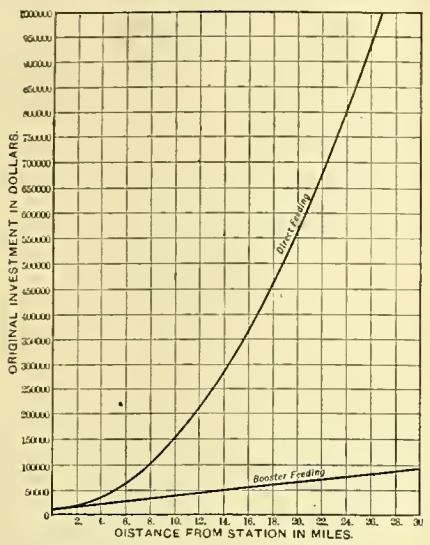



FIG. 1. USE OF THE BOOSTER IN ELECTRIC RAILWAY CIRCUITS.—INITIAL COST OF STEAM AND GENERATING PLANT, COPPER AND SPECIAL APPARATUS FOR DELIVERING 200 AMPERES AT 500 VOLTS.

of a machine which shall automatically raise the initial voltage above that of the bus-bars by an amount which may exactly equal the drop in potential on the feeder at that instant.

When using this machine we calculate our feeder for ampere capacity only, and constantly maintain the pressure at the service end of the feeder equal to the pressure at the bus bars, irrespective of the length of the feeder or the load.

In any given instance the cost of a direct feeder increases with the square of the distance, while the cost of the booster feeder is directly proportional to the number of miles. These characteristics of the latter system result in a reduction of first cost of from 25 to 75 per cent. as compared with the first cost of the ordinary direct-feeding methods of our present practice; and it thereby becomes possible for numerous electric street railway companies to extend their lines into suburban localties from ten to twenty miles distant from the power station, at the same time retaining the investment within reasonable limits.

In order to present these matters in a manner easily comprehensible, we can readily establish equations for the two systems to be compared; and then, by assuming certain accepted values, plot the results.

Let

$C_1$ = Current delivered to trolley wire.
V = Voltage at generator.
$V_1$ = Voltage at trolley wire.
$V_2$ = Voltage of booster.
Eg = Efficiency of generating apparatus.
Eb = Efficiency of booster.
E′ = Operating expenses for direct feeding—coal, oil, water, waste, engineers, firemen and interest on so much of the steam, generating and transmission plant as is due to the feeder under consideration.
E″ = Operating expenses for booster feeding—details as before.
M = Length of feeder in miles.
m = Circular millage of feeder.
$ = Inital cost of as much of the steam, generating and transmission plant as is due to the feeder under consideration.
I = Per cent. interest on investment.
D = Per cent. depreciation on investment.
s = Cost of steam plant per horse power.
g = Cost of generating plant per kilowatt.
b = Cost of booster per kilowatt output.
k = Cost of insulated wire per pound.
p = Cost of placing 5.544 feet No. 4-0000 wire, including insulators, pins, cross-arms, sundry hardware and labor; 5 per cent. allowance for sag.
z = Cost of supplying one horse power per year, in quantities of over 100 horse power.

Then for direct feeding:

$$\$=\frac{\frac{C_1V_1}{746}+\frac{C_1(V-V_1)}{746}}{Eg}s+\left\{\frac{C_1V_1}{1000}+\frac{C_1(V-V_1)}{1000}\right\}g+\frac{2315.488\ M^2\ C_1}{V-V_1}k+\frac{.5664\ M^2\ C_1}{V-V_1}p \qquad (I).$$

And for booster feeding:

$$\$=\frac{\frac{C_1V_1}{746}+\frac{C_1(V-V_1)}{746}+\frac{C_1V_2}{746}}{Eg}s+\left\{\frac{C_1V_1}{1000}+\frac{C_1(V-V_1)}{1000}+\frac{C_1V_2}{Eb}\right\}g+\frac{C_1V_2}{1000}b+.019318\ m\ M\ k+\frac{m\ M}{211600}p \qquad (II).$$

Substituting the following values in equation I.:

$C_1 = 200$
$V_1 = 500$
$V = 550$
$s = 45$
$Eg = 00.95$
$g = 25$
$k = 00.13$
$p = 75$
$b = 50$

We have:

$$\$=9735+1374\ M^2 \qquad (III.)$$

Substituting the same values in equation II., assuming 211,600 as the value of m, taking Eb=.90, and finding an expression for $V_2$ in terms of M, we get:

$$\$=8732+2857\ M \qquad (IV.)$$

In order to graphically represent the relation between initial investments in the two methods of feeding under discussion, equations I. and II. have been solved for varying values of M from 1 to 30, and the results plotted on Fig. 1. An inspection of this diagram shows at once the immense superiority of the booster system over direct feeding in cases where first cost is the essential feature. It will be noted that the curves have been carried out for the entire thirty miles without regard to the practical voltage limit in direct-current machines, or the point at which the cost of operating an independent station becomes less than operating from the main station.

Fig. 1 shows that for distances greater than one and one-half miles it will cost less to install a booster system than to place copper and machinery in the usual manner for feeding direct. In cases where motive power is water, costing little or nothing per horse power, these curves give at once the relative economy of the two methods; but ordinarily, on account of the consumption of coal, the loss in the line (represented in the new method by the power required to operate the booster) becomes an important factor in the discussion; and it is necessary to establish equations for the operating expenses, taking into account the fixed charges of interest and depreciation on the investment, as well as the cost of furnishing the required power.

The following equations will enable us to determine these values for different distances:

Direct feeding:

$$E'=\frac{\frac{C_1V_1}{746}+\frac{C_1(V-V_1)}{746}}{Eg}z+\$(I+D) \qquad (V.)$$

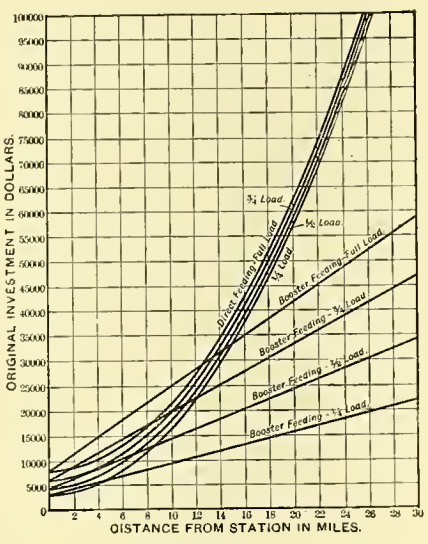



FIG. 2. USE OF THE BOOSTER IN ELECTRIC RAILWAY CIRCUITS.—OPERATING EXPENSES OF PLANT DELIVERING 200 AMPERES AT 500 VOLTS, INCLUDING COAL, OIL, WASTE, WATER, LABOR, AND INTEREST AND DEPRECIATION ON THE INVESTMENT.

Booster feeding:

$$E''=\frac{\frac{C_1V_1}{746}+\frac{C_1(V-V_1)}{746}+\frac{C_1V_2}{746}}{Eg}z+\$(I+D) \qquad (VI.)$$

Making the same substitutions in equations V. and VI. as were made in I. and II., placing (I + D) = .10, and remembering that \$ varies according to the method and distance under discussion, we get:

$$E'=155\ z+\frac{\$}{10} \qquad (VII.)$$

$$E''=(139+36\ M)\ z+\frac{\$}{10} \qquad (VIII.)$$

Fig. 2 represents these equations plotted for varying values of M, z being taken at 40.

The intersection of the upper curve with the upper straight line is the point at which the booster system costs as much to operate as does the direct system. This distance we find to be twelve and one-half miles. For shorter distances, direct feeding is more economical, while for longer distances the booster system has an absolute advantage. Now, the assumption upon which equations V. and VI. were solved is a feeder constantly loaded to its maximum capacity. The absurdity of this assumption is apparent when one considers the actual conditions which obtain in railway work; the average load on the feeder during the entire year will be more nearly one-third or one-quarter of the maximum. We have therefore established and plotted equations similar to V. and VI., but for three-quarters, one-half and one-quarter load, and the resultant curves are shown on Fig. 2 in order to afford ready means of comparison.

A careful study of these diagrams demonstrates in what the economy of the booster system consists. While the method we have outlined may seem like robbing Peter to pay Paul, it must be remembered that in direct feeding there is a large amount of capital invested in the pole line, accruing interest day and night, in storm and sunshine, irrespective of the traffic on the line; while with booster feeding the interest on copper investment is nominal, the power required to drive the booster itself being proportional to the load on the line. Thus we can readily understand why, under the conditions given, with an average load

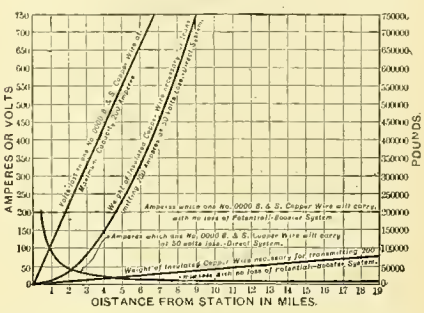



FIG. 3. USE OF THE BOOSTER ON ELECTRIC RAILWAY CIRCUITS.—COMPARISON BETWEEN DIRECT AND BOOSTER FEEDING FOR RAILWAYS. RESISTANCE OF RETURN CIRCUIT (RAILS)=RESISTANCE OF FEEDER. ALLOWANCE FOR WEIGHT OF INSULATION=15%. ALLOWANCE FOR SAG=5%. SHOWING THE INVESTMENT SAVED IN WEIGHT OF COPPER BY MEANS OF THE BOOSTER SYSTEM.

of one-quarter the maximum, the booster system is absolutely more economical than the direct feeding system for distances over four and one-half miles.

The equations we have laid down will serve to answer any questions that may arise as to relative first cost or operating expense. It has been impossible to represent results derived under varying conditions without multiplying the diagrams indefinitely. All calculations have been based upon the most recent methods of rail bonding and track feeding; and the assumption that the resistance of the return circuit is equal to that of the outgoing circuit is therefore perfectly safe.

It may occur to some that the installation of a special high-voltage generator to supply the feeder in question would be a simpler method of reducing the copper; but a cognizance of the enormous variation in drop under extreme changes in load on a long feeder calculated for ampere capacity only leads at once to the discarding of such a scheme until such time as manufacturers can furnish efficient generators over-compounded from 50 to 150 per cent.

The adaptability of the booster to railway work of all kinds is wonderful. A few specific instances are noted, in the confident belief that the suggestions thus thrown out will impel each and every electric railway manager to personally investigate this system with a view to ascertaning exactly how far it would prove of advantage when applied to his particular road.

Ordinarily, in calculating copper for distribution, we are obliged to allow for special features influencing traffic, such as ball grounds, race tracks, picnic groves, etc. As there is seldom any necessity for bunching cars at all these points simultaneously, and as the various features are usually scattered, it follows that atall times one or more of the feeders is lying comparatively idle. Under the plan suggested the copper is figured for average conditions, and a booster, placed in the station, is arranged to be thrown immediately upon any feeder which may become burdened with an excessive load.

Another feature of this system which makes for economy becomes prominent on long suburban lines forced to run an infrequent schedule late at night. On such a road the booster may be shut down and cut out of circuit entirely when the load on the long distance feeder drops to, say, one-quarter of the maximum, depending upon the amount of copper in the line.

If this surburban line extends to a park or pavilion which is open only during the summer months, the advantage of the booster over direct feeding is enormous, since the investment on a booster lying idle is a small fractional part of the interest on the idle copper of a direct feeder.

On many roads already in operation the copper in the line has proven entirely insufficient, and the erection of additional feeders is contemplated. Would it not be worth while to consider the installation of a booster at one-tenth the cost of the extra copper, provided calculations showed the economy of operating the two systems to be equal?

In the progress of electric railways, as in the growth of cities, development frequently fails to follow the lines predicted for it. It therefore happens that many a road to-day is worrying along, the victim of misplaced judgment—and copper. In many instances the adoption of a booster and a redistribution of the present copper will remedy the evil in the most economical manner.

In large cities, such as Boston, Brooklyn and Philadelphia, the tons of copper could in this way be largely reduced with a gain at the same time in uniformity of pressure. Such a reduction will become imperative the moment the authorities order the feeders and mains underground.

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CIRCULATION, 16,630.

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THE recent convention at Atlanta, Ga., directed attention to the progress made by the electric railway in the South. It was not generally appreciated that so much had been accomplished in the last few years, but a careful study of this subject establishes the fact that in the South as in the North the trolley has grown in public favor, that it needs only to be known to be appreciated. A careful perusal of the article presented elsewhere will repay anyone interested in this subject.

IT is believed that an organized movement will be set on foot soon with the view of increasing the carrying capacity of the Erie canal. Changes will be necessary before electricity can be economically employed in the propulsion of boats. At a conference of canal men at New York recently this subject was discussed. It was decided to urge the adoption of measures by the state for the necessary improvements. Immediate action is deemed necessary, as the volume of business is constantly dropping off and still further competition is threatened.

DURING his last term as mayor of New York Hugh J. Grant ordered the destruction of many miles of overhead electric lines involving a loss of hundreds of thousands of dollars, and under his direction a pole-chopping brigade was turned loose upon the city. There was no good excuse for this wholesale destruction of valuable property, yet Mr. Grant, who is again a candidate for the high office of mayor of New York, is appealing to the people for support because of his crusade against the overhead wires. The electrical interests of New York have reason to look with disfavor upon Tammany's candidate. His course in treating the overhead wire problem showed a lack of judgment that was not to be looked for in a man holding such a high office. In order to gain a little notoriety Mayor Grant plunged the city in darkness and practically turned it over to the mercy of the criminal classes. It would seem as if the business men of the metropolis, remembering the days of Grant's second term, would hardly care to invest him again with so much authority. It is safe to say that no other city would submit to such reckless exercise of authority, but New York cannot be counted on to act like other cities.

ASIDE from the attention commanded by Mr. Dyer's paper before the Atlanta convention because of its practical value, it was particularly interesting to managers of large trolley systems, disclosing as it did the fact that a regularly organized department had been established and was considered necessary by the West and North Chicago Street Railway companies to look after personal injury cases on those roads. So much has been said against the "deadly trolley" that it is not without satisfaction that managers of electric roads learn of the elaborate arrangements that have been made to look after accidents upon cable lines. The working force of the department described consists of a medical staff and a sufficient number of investigators, all under the direction of the chief adjuster, who reports to the legal department of the road. Employes are obliged to notify the company immediately of any accident in order that a physician and an investigator may be sent to the scene at once. The case is followed up and evidence is compiled for the claim department, and should the company find it impossible or not desirable to settle with the claimant, the legal department has the advantage of the information collected through these agencies. Mr. Dyer says, in conclusion, that "the time is at hand when all railroad corporations must be prepared to resist claims in a large percentage of their accidents. To promptly prepare to do this is the part of wisdom, when considered from a financial standpoint, usually the determining consideration in corporate management." There are very few trolley systems in the country, it may be said, which would be warranted in organizing such an elaborate system. Cable roads, however, have felt the need of departments of this kind.

ANOTHER rebuke has been administered to Mayor Pingree of Detroit and his following, who, during the last four years, have been engaged in a war on the Detroit Citizens' Street Railway company, claiming that its franchise was illegal and should be forfeited. After prolonged litigation the city was beaten in the United States Circuit Court and in the United States Court of Appeals. Application was then made by the city officials in sympathy with the mayor to Attorney-general Ellis for leave to commence quo warranto proceedings in the Michigan Supreme Court to compel the street railway company to vacate the streets. The attorney-general, after reviewing the case thoroughly, has written an opinion, denying the application and declining to allow the state to be made a party to the litigation. The opinion leaves no doubt as to the standing of the city. The position of the street railway company is sustained throughout, as the attorney-general holds that the city of Detroit had the right to grant the easement to the use of its streets; that having granted it for thirty years, in 1879, it had the right to make such grant beyond the corporate life of the corporation to which the easement was given. "The only reason why the city desires a forfeiture of the franchise," the attorney-general said, "is that it had made a bad bargain, and I cannot ask the state to step in and help the city get a better price for what it has to sell." There is but one more step possible before the final retirement of the mayor's party. The city may apply for a mandamus to compel the attorney-general to file information in quo warranto proceedings, but it is not expected that this will be done. The mayor has been beaten at every point in the controversy, and the people will be called upon to pay the bills. More than that, they have been deprived of the advantages of improved street railway service, which the company of course was not willing to furnish as long as the litigation was in progress. That corporation will now begin work that should have been commenced four years ago, and that would have been completed long ago but for the unfortunate policy adopted by the misguided gentleman who occupies the position of chief magistrate of the city.

THE brilliant but erratic *Sun* is desperately in earnest in its opposition to the proposed rapid transit scheme which will be submitted to the people of New York for approval on next Tuesday. That journal is practically alone in its fight against this measure, and, so far as can be seen, there is little interest manifested by the people generally in the subject further than a desire to secure better service than is afforded by the elevated. That the present facilities of the Manhattan company are inadequate to meet the demands is generally conceded, and it is contended that permanent relief cannot be obtained through extensions of the "L" system. It is said that the Manhattan company is doing everything possible under the circumstances, and that further relief can only be obtained through the building of an underground railway system like that proposed by the Rapid Transit commission. That the *Sun* is eager to defeat this measure will be realized at once from the fact that it has warned the people that they are placing a great temptation before Tammany when they vote for the proposed measure. "Matthew Marshall," the financial writer for the *Sun*, says: "I have pointed out that the Tammany Hall democrats turned round and favored the municipal rapid transit scheme as soon as the possibilities for public plunder in it were shown to them." He alleges that the high standing in the community of the men composing the commission is no guarantee that the people's interests would be guarded. The fact that these commissioners, he says, "have accepted their offices at all discredits their ability and their judgment; and, although their integrity may be above suspicion, yet in case it should prove troublesome, there is nothing to prevent its being removed out of the way by partisan legislation." Attention is called to the fact that the commission which was originally created for the construction of the new Croton aqueduct was composed of men very much of the same description as those now intrusted with the carrying out of the municipal rapid transit scheme, but the original commission, it is asserted, was speedily replaced by politicians, who were put in for the avowed purpose of making it contribute to party purposes. In conclusion: "Once let the expenditure of $50,000,000 be commenced and it will be impossible to keep politicians of one party or the other, and probably both, from getting control of it." This is rather interesting reading, especially in view of the relations between Tammany and the *Sun*, but it is really only another instance of the power wielded by the Gould interests. It will certainly be an important advantage for the people of New York to secure the substitution of an electrically operated underground road for the present noisy, dirty and unsightly elevated system.

TELEPHONE men very generally hold to the opinion that electric railway companies should provide complete and adequate metallic circuits for their working current, the same as lighting companies, although they themselves use the earth return to a very large extent, employing, however, but a slight current. The old question of the conflicting rights of electric railway and telephone companies in the highways has usually been decided in favor of the former by the courts of the United States, which hold, as a rule, that the railway companies, in transporting passengers, are furthering the purpose for which the highways were constructed, and have thus a right superior to the telephone companies, which in no way contribute to the public convenience by placing their wires in or over the streets. The telephone people are thus forced to seek their own protection from the evils of induction and electrolysis due to the neighborhood of the conducting wires of the electric railways, although, in respect to electrolytic action, many other complainants are at one with them in endeavoring to secure immunity from the escaping current of earth return electric railway systems.

Although there are comparatively few electric railways in Europe this subject has already attracted considerable attention in Great Britain and on the continent, and in a recent number of the *Elektrotechnische Zeitschrift* Dr. V. Wietlisbach of Berne, Switzerland, contributes his views to the discussion. It is shown that in Switzerland the difficulty due to electrolytic action has been overcome by the arrangement of a copper wires even to eight millimeters thick (of the same carrying capacity as the contact wire) near the track. This wire is connected to the rails at intervals of at most 100 meters, and with the generator at the power station. Experience has shown that by use of this wire the so-called roaming, or "vagabondizing," as Dr. Wietlisbach puts it, currents are completely removed, at least from telephone wires. The prevention of induction is naturally much more difficult; but, as the result of his experiments, Dr. Wietlisbach comes to the following conclusions: (1) that the parallel arrangement of single telephone wires for a length of even 100 meters in the same street as an electric railway is bad practice; (2) that with the loop system the parallel method is practicable for about five kilometers, although all wires along the route must be looped; (3) that long lines, especially those connected with other long lines, are best carried another way; (4) that crossing is not injurious if not too often repeated, and if it is effected in a suitable vertical distance from the railway contact wire.

These figures are the result of careful research, and are interesting as a basis for comparison with American practice.

## Unipolar Dynamos for Electric Light and Power.[1]

CARL HERING: Prof. Crocker has worked out the shape of the field theoretically, but in practice I think it could be changed to advantage by making the polar surfaces at air-gap a little larger than he suggested, because by far the largest part of the reluctance of the magnetic field lies in the air-gap, even if an iron armature is used. Prof. Crocker speaks of the reaction of the armature as not interfering appreciably with the field; in this I think he is no doubt correct, as the reaction of the armature will simply shift the

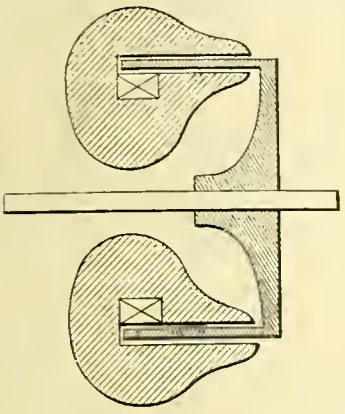


FIG. 1. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER WORK.—CROSS SECTION OF FIELD MAGNET MODIFIED TO GIVE GREATER POLE AREA.

lines of force and perhaps make the magnetic circuits longer, but it will not make the field un-uniform. But it is different with the currents from the brushes to the outside of the machine; unless these currents are led out perfectly evenly through a disk they will produce an irregularity in the field which will cause foucault currents in the armature, as Prof. Crocker stated in the beginning of his paper. I think one of the difficulties in the working of such machines lies in this irregular shifting of the fields due to the currents in the leading-out lines. About ten years ago I suggested that this might be partially overcome by leading the wires out in the form of a spiral in the plane of the exciting coil, making it a sort of continuation of the field coil, but I hardly think that it would be practicable. Prof. Crocker has not made any allowance in his theoretical design for the open space which must be left near the coil space for the brushes. The brushes for such a machine must be quite large and numerous, and there must be quite a large space left for them next to the coil space; this in turn will change the proportioning of the field. Another difficulty lies in the fact that those brushes must necessarily be in the inside of the field, where they are not easily accessible. The machine must, therefore, be designed so that it can easily be opened at this part, so as to get at those brushes without requiring too much skilled labor and too many special tools; this will affect the simplicity of the machine somewhat. Regarding the term unipolar, I think myself that it is a very unfortunate one, but there is one way of looking at it which, perhaps, partially justifies its use. We can imagine unipolar as

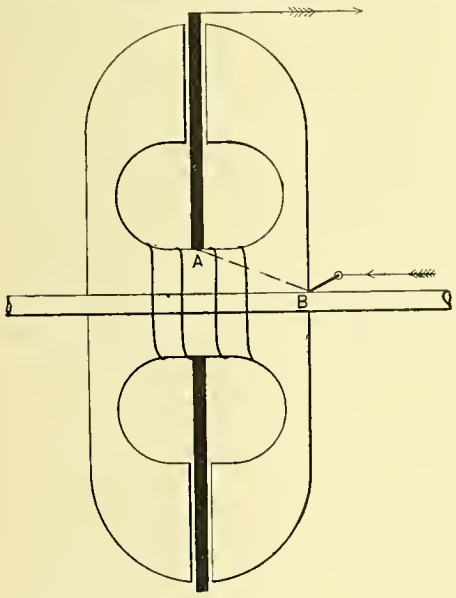



FIG. 2. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER WORK.

applying to the currents of the armature, in which case it means a current which is always in one direction as distinguished from one which is alternately in two opposite directions, as in the ordinary dynamos. This may serve at least as an excuse for the word, even if it does not justify its use. Regarding the maximum speed that Prof. Crocker has calculated, I would like to ask whether that is with or without a factor of safety. If it is without a factor of safety, it seems to me that the dimensions calculated in those examples would have to be altered quite materially, because in a construction of that sort the factor of safety is an exceedingly important quantity. Even if it is taken as low as three, which is rather low for engineering structures of that kind, it will make quite a difference in the size of the machine.

PROF. CROCKER: I will answer Mr. Hering's remarks in order. In regard to the air-gap I have with me a blue print of a design which shows the increase of the pole area as indicated in the sketch. A very small addition of material would greatly increase the pole surface. The weight of the machine would not be materially changed, and all the formulas and relations would not be substantially modified. Of course, in starting out, we must have a ground work, which can be varied slightly in order to fulfill practical requirements. As the clearance is very small and the magnetic circuit short, I expect to have sufficient magneto-motive force to carry the lines of force across that air-gap even at a high density. In regard to the holes for the brushes, and the disturbing effect which the current would have where it came out, that could be overcome by having it brought out at a number of points. If necessary, more space could be allowed for the brushes, which might consist of blocks of metal or carbon resting on the surface of the cylinder or disk, the current being brought out by strips of copper passing through holes in the machine, as shown in Fig. 1.

This trouble could be overcome by having a copper band around the armature where the current is taken off, which would act as a sort of collector to bring the current to the brush contacts. Various schemes of that sort will suggest themselves. Of course, the field magnet has got to be split in order to get the coil in. It could not be made solid, and it would be desirable to have it split up more or less in order to facilitate handling, etc.

In regard to the factor of safety: I stated in the paper that the safe allowable stress is assumed to be 10,000 pounds; that is derived from Thurston's work on the steam engine. Of course, steel will have a breaking strain far in excess of 10,000 pounds, and even 20,000 pounds working stress allows a factor of safety of three or four, and considering that the armature is absolutely enclosed, and could do no harm if it burst, I think that is sufficient. Of course, we could make this disk or cylinder of forged steel, if necessary. There is nothing to prevent it, though it would

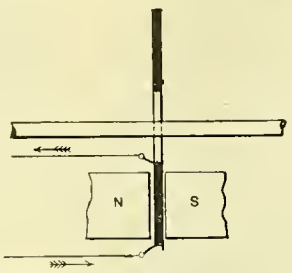



FIG. 3. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER WORK.

increase the cost somewhat. I think those are the principal points you mentioned. In regard to the name "unipolar," I think we must accept it, whether it is good or bad.

MR. STANLEY: Some time ago I constructed a very simple machine which perhaps might be of interest to the Institute; reversing the whole design that Prof. Crocker has illustrated, keeping the conductor still, and moving the magnet, getting rid of the outside contact. The trouble that I found in making such a machine was that I could not work with anything like such peripheral speed as Prof. Crocker suggests; so I took a copper band, and constructed a machine very much like Mr. Mordey's alternator. The copper band, porjecting above and below the field, was permanently connected to one terminal of the circuit. The magnetizing coil was placed in the cavity here as in the Mordey machine, and then a smooth surface brush, running at a low speed, kept contact with the interior of the copper band, and the current from the interior edge of the band was drawn off through the shaft of the machine. In this way I could increase the size of the machine very greatly and keep the peripheral contact speed down. Now this is perhaps very well, but what is the use of it all? Why do we want such a unipolar machine when we can take a copper band, as Ferranti has done, and simply saw it up as Mr. Mordey has, and take both contacts outside, and so have no sliding contact whatever. In this way we get approximately the same output from the machine that Prof. Crocker points out, and have all the advantages of the unipolar design. I cannot see why we want to construct unipolar machines because they are unipolar. In the Mordey machine there are no sliding contacts. The type of the machine is only limited by the capacity to carry the currents generated, and there is very little armature reaction, and so it seems to me it would be going backward to attempt to build a machine with a contact speed of 500 feet a second.

MR. KENNELLY: Some of the difficulties which are mentioned here, while they are no doubt considerable, may perhaps be still further reduced by proper methods of construction and design. Mr. Stanley has brought up an argument against resuscitating this machine, showing that so simple a departure from this particular type will give a high pressure alternating current generator, but that seems to me to introduce another question, the advantages of alternating versus continuous currents. Because if you were to make a continuous current dynamo of the same pressure, you would have to introduce the commutator and its disadvantages of cost and maintenance, etc. The paper deals with the continuous current generator and shows how the commutator can be avoided by utilizing a high peripheral surface speed. So the whole question at issue is, is it advantageous to do away with the commutator and replace it by an armature of very simple construction, of large diameter, perhaps with a high peripheral speed of brush contact. But there are one or two difficulties mentioned here, and which have been raised in discussion, that seem to me not so great as they look at first sight. For example, I do not think that any danger need to be anticipated from such a small trouble as a blow hole. Those who have tried to produce eddy currents in a revolving sheet by deliberately making a very irregular field, heavily grooving it or putting cavities in it, will realize how deep the cavities must be to produce serious disturbance of that character, and the reluctance of the air-gap is usually so great that the difference of density which is produced by any local variation on the surface is not large and still less where the cavities, as in blow holes, are hidden from sight. The great necessity of uni-

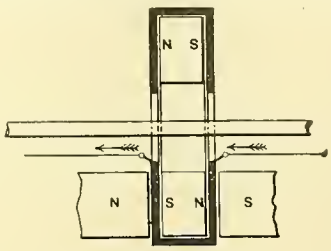



FIG. 4. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER WORK.

formity of the field density is only in one direction. If the flux density varies along any circle, then there will be a tendency for the eddy currents to produce themselves. But the flux densities may vary from the center to the periphery in the most arbitrary manner, provided that whatever variation takes place at this radius is symmetrically reproduced all around. The form of field-magnet which is presented in this paper and which has struck Mr. Hering so forcibly as being unnecessary has probably, I presume, been introduced with the idea of constructing a gigantic machine, because the larger the machine is, the less is the fraction of the total reluctance formed by the air-gap and the greater is the value of the iron in the immediate vicinity of the air-gap.

MR. STEINMETZ: In this problem of unipolar machines we have to be very careful to guard against a mistake which is made quite frequently, especially in trying to reverse the action of a machine. In an electrical conductor an electromotive force is induced, if it moves through or relatively to a magnetic field, that is, either if the magnetic field varies in intensity or if the magnetic field is constant and uniform, and the conductor moves through the field. Now take this unipolar machine.[1] There is a constant magnetic field, that is, a field which has at any point in space a constant intensity and constant direction, no matter whether you revolve or do not revolve the magnet; because if you abandon this idea of lines of force, which is nothing else but a physical hypothesis, and go back to the original meaning of the magnetic field, as the intensity and the direction of the magnetic displacement in the ether, you can find that in the machine, even if you revolve the magnet, the field is constant. Thus you can very easily get a machine which can never do anything. Take the machine that Mr. Stanley showed us, Fig. 2. Whether the magnet and the magnetizing coil stand still or whether they revolve, the intensity and direction of the magnetic field at any point is constant. Hence, there is no electromotive force induced in the stationary armature conductor. Still you get a current from the machine. But where is the seat of the electromotive force? It is where the lines of force are cut. That is, inside of the revolving magnet, in the line *A B*.

The very large diameter of armatures necessary in a unipolar machine is no serious objection; because in direct-connected alternators we have running in this country armatures of 12 feet and 16 feet in diameter, though not with 200 rev-

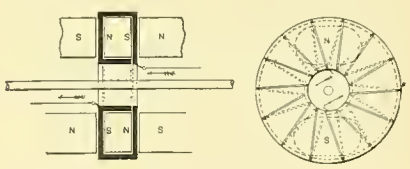



FIG. 5. UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER WORK.

olutions by any means. But where I see a more serious objection is that I fear the efficiency of the machine will be very seriously reduced by the brush friction, because you need an enormous brush to take off the current, and even if you use very little pressure of the brush, still you must consider that you have a speed of five to six miles per minute, or over 300 miles per hour. These are tremendous speeds, about three times as high as the highest speed reached in revolving dynamo machinery, and about eight times as high as the highest brush speed on collectors or commutators. As to taking off the current by mercury contacts, I have never tried it myself, but I remember some remarks of Professor Forbes about it. He said he had tried it and had been very unsuccessful. His statement was something like this: That he could not get any current because before he could get any current the mercury had evaporated by friction.

I tried myself some years ago to build a unipolar machine to solve this problem of multiplying the electromotive force by coiling the conductors, and I succeeded in it. It was very successful, indeed, only when I was through it and saw what kind of machine I got I was thoroughly disgusted and gave it up. I think I can show you the chain of reasoning.

1. Discussion of paper by Prof. F. B. Crocker and C. H. Parmly, read before the American Institute of Electrical Engineers, Philadelphia, May 16, 1894, and printed in the WESTERN ELECTRICIAN, June 9, 1894.

1. WESTERN ELECTRICIAN, vol. xiv., p. 284.

It is quite interesting in showing what a unipolar machine speculation can lead to. I started with Faraday's disk, Fig. 3. The magnet is *N S*. Then electromotive force is induced, say, in the direction of the arrow. To multiply the electromotive force I took a second disk.

Now, connecting the outsides of the disks with each other in Fig. 4, I could return the electromotive force of one disk by the other, and thereby bring the two brushes to the center, as shown in Fig. 4. By doing this, I have to revolve the part of the magnetic circuit between the disks, that is, to make a kind of an armature, consisting of an iron ring between the two Faraday disks.

Evidently these disks have to be slotted to get rid of eddies. But if you slot them you are enabled to coil the conductor, as shown in Fig. 5, by offsetting the slots, so that the circuit leads from one segment to the next, and thus you have solved the problem of coiling the conductor in the unipolar machine; but if you look at what you have, in Fig. 5, you see it is nothing but the regular bipolar dynamo. Since that time I have given up trying to improve unipolar machines.

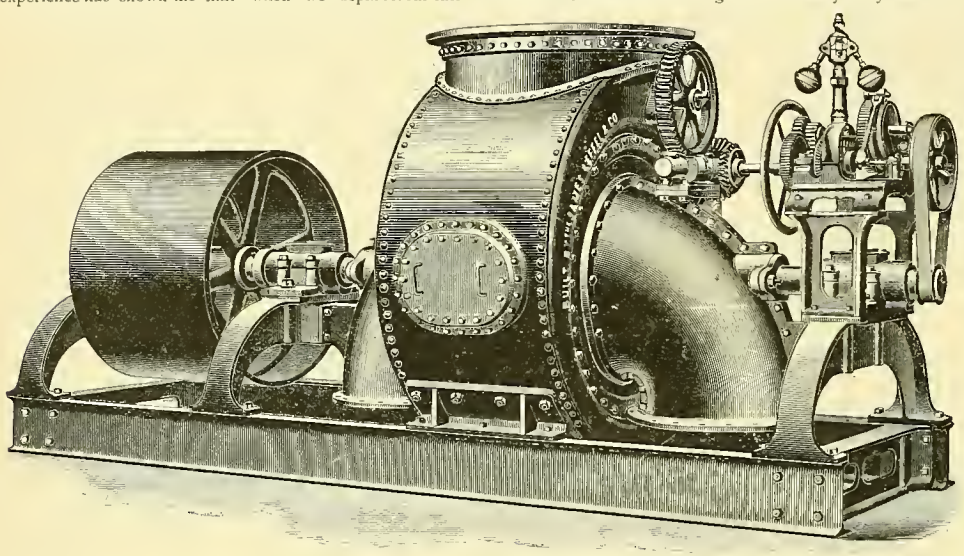
PROF. CROCKER: In regard to what Mr. Stanley has said it seems to me that, as Mr. Kennelly stated, it is simply the question of the alternating versus direct current, which is not the subject under discussion. But taking the case as Mr. Stanley stated, we should have there all the complications of of armature windings. You would entirely lose that simple and solid armature construction. You would require insulation, etc.

You complicate greatly the mechanical construction. Furthermore, the alternator certainly would not do for electrometallurgical purposes. It would not do to-day, for instance, for a central station, where they are using direct current and want another dynamo to give a larger output. This paper relates simply to unipolar direct current machines, and I was not comparing them with alternators. I was comparing them to the ordinary type of direct current machines. In regard to what Mr. Steinmetz has said, those ideas are exactly the things I wanted to avoid. My experience has shown me that when we depart from this simple disk or cylinder construction, we get into all these complications, and finally arrive at a result which is very inferior to the ordinary Gramme or Siemens machine.

## New Double Discharge Turbine.

The illustration presented herewith represents a unique design of a new type of turbine wheel on a horizontal shaft. It is simple in form and capable of easy and very substantial construction. This illustration is a reproduction from a photograph of a wheel in actual practice, driving a portion of a large electric plant where several others of the same design and style are in use, under a working head pressure of 90 feet. It will be seen that the water enters vertically at the top. The design, however, admits of receiving the water at any inclination from a vertical to a horizontal line. When it enters this outward casing, in which is placed the guide casing of the wheel or runner, the water completely surrounds the guide casing, under whatever head pressure the wheel is placed, and is admitted to the circumference of the runner or wheel proper through the guides, leaving the wheel after doing its work. The runner itself is a double wheel, receiving the water from a single set of guides, which surround the circumference of the runner. The wheel is so constructed as to divide the water into two equal portions on receiving it from the guides; these equal quantities each operate upon the wheel, and at the same time discharge the water horizontally in opposite directions, on the performance of its work. The water then passes through the curved tubes on each side of the wheel and discharges into the tail water below. This method of application of water to a turbine entirely avoids end thrusts or end pressure of the shaft; in other words it prevents the water from getting between the wheel and any part of the casing, avoiding loss of power therefrom. The wheel is in this manner relieved from excessive friction; a source of loss that often occurs in various styles of turbines. The wheel illustrated is 30 inches in diameter and of 550 horse power capacity. Its regulation is nicely secured automatically by means of a governor shown in the cut.

This regulation is peculiar to the form, design and construction of the wheel, rendering it highly efficient as a motor for electric light, electric power and various purposes. The concern using the wheel illustrated recently applied for another of the same pattern of 400 horse power, having a diameter of 26 inches. The wheel shown has a pulley of 42 inches face, 48 inches diameter, transmitting the whole power through a 40-inch belt to the electrical machinery. The design is essentially the same as that of the two turbines, each of 1,200 horse power, built for one of the companies which will utilize the power at Niagara Falls, except that in those wheels neither pulleys nor governors are used, the power being applied directly to the machinery at each end of the water-wheel shaft on each side of the turbine. Three pairs of a modification of the type of wheel illustrated were recently supplied to an electrical plant in Mexico, each pair being 20 inches in diameter and of 600 horse power; nearly 1,800 aggregate horse power. The transmission in this instance was 18 miles. James Leffel & Co., Springfield, O., make a specialty of this design and line of work.



NEW DOUBLE DISCHARGE TURBINE.

## Statistics of the Telegraph.

The statistical abstract lately issued by the British Board of Trade gives information regarding the growth of telegraphic communication in the principal European countries and in the United States during the last twenty-five years. No data are given for Russia, and the statistics for that country come to end with 1880, Russia being then fifth in the list of countries as regards the number of messages carried. The smallest number of messages dispatched in 1870, the first year selected, was 466,700, in Norway, and the largest number, 9,350,000 in Great Britain. Germany was third in the list, with 8,207,800 messages. The United States had a slightly smaller number of messages to its credit than Great Britain, the total being 9,157,646. In 1892, after the lapse of twenty-two years, Norway had still the smallest number of messages carried, viz., 1,649,544. Germany seems to have dropped from third place to fourth, with a total of 31,175,100. No figures are given for France in 1892, but in 1891 the number of messages carried was 32,397,000. The United Kingdom still retains the first place, its total in 1892 being 69,908,600, compared with 62,387,298 in the United States. Austria held fifth place in that year with 10,835,302, and Italy seventh with 8,322,925. Regarding the proportion between the number of messages carried and the population as a whole, it appears that in 1870 Russia showed the smallest proportion of messages carried per head, only 0.04 per head of population. Of the five countries which held the next lowest rank to Russia as regards the proportion of telegrams to population, viz., France, Italy, Sweden, Spain and Hungary, the first named has since made the greatest strides, and is now among the first five countries compared in this respect, increasing from 0.1 to 0.9. Switzerland, in 1870, was first among the countries, with 0.6 message per head. In the interval its proportion has been doubled, but it now holds only second place, the United Kingdom being first with 1.8 messages per head. The United States, with Holland and Belgium, falls into third place, having 0.9 message per head.

## Resolutions of Thanks.

The eastern delegates and visitors to the Atlanta convention have adopted resolutions of thanks to the Pennsylvania Railroad and the Southern Railway companies and their representatives for courtesies extended during the trip.

## New Plant of the E. G. Bernard Company.

During the last few months the Watervliet arsenal has been the only post in the United States lighted by kerosene lamps. For a period of time previous, however, an entire new electric light system had been erected within the grounds and shops connected therewith, but upon the completion of the plant an injunction was served upon Major Arnold and the E. G. Bernard company by the Edison Electric Light company, restraining the use of the newly erected system. Last week the injunction was removed, and the system lighted the grounds for the first time. The system erected by the E. G. Bernard company is described as being very simple in construction and less liable to get out of order in case of war.

As erected in the arsenal there are two complete plants, situated about a quarter of a mile apart, and connected in such a manner that either can furnish the required current to operate the lighting or power circuits in the grounds, shops or other buildings. Plant No. 1 is situated in the engine room of the new gun shop, and consists of two 100 kilowatt generators. Plant No. 2 is located in the lower or old shop, and consists of two 50 kilowatt generators. Attached to each plant is a motor-generator, used as an equalizer, which permits the government to use any one of its generators, and which comprises 110 volts and 220 volts current at the same time. The 110 volt current is used for illuminating purposes and the 220 volt for power. Mr. Bernard of the E. G. Bernard company designed two new switchboards for this plant, which allow every wire and connection to be in sight of the person operating it, giving every possible combination of connections on the several circuits, and insuring against any possible breakage. He also designed and laid out the whole special system of wiring, etc. The entire system is valued at $30,000, and is perfect in every detail. This includes the expense of the removal of the Edison and Thomson-Houston apparatus by the E. G. Bernard company.

Fifty-three lights are situated in different parts of the grounds. The gun shop is lighted with over 800 lamps, the smaller shops having over 300 lights, while the officers' quarters are illuminated with about 350 lamps. The soldiers' quarters, barracks and offices are supplied with 200 lamps, while scattered about the grounds are 100 more. Power is furnished to run the 75 ton, 30 ton and 150 ton cranes in the new gun shop, the cranes having from one to four motors each. The system is so arranged that all available water power can be used for lighting and furnishing power as well. In case the water is drawn from the Erie canal, which furnishes the water for power, one of the generators in the lower shop can be so arranged as to furnish a motor and current to operate the same from number one plant in the gun shop. The system is so arranged that a current for lighting the quarters, or to be used in any part of the grounds for any purpose, can be furnished by water power exclusively, which means a large saving to the government, as the water is not utilized in any other manner, more especially at night.

## Important Telegraphic Transfer.

In Baltimore on October 23d a deed conveying to the Western Union Telegraph company all the lines and property of the American Rapid Telegraph company was filed in the record office of the Superior Court. The consideration is $550,000 in the capital stock of the Western Union company. The property is sold by James W. Converse, Joseph and Ann Maria Sawyer, Edward L. and Susan Giddings, George Henry and Mary C. S. Quincy of Boston, Mass., and Charles B. Lancaster of Newton, Mass. These persons originally bought it in 1891 at a foreclosure sale to satisfy a mortgage for $4,156,385 held by the Boston Safe Deposit & Trust company. There are six wires running from Philadelphia to Baltimore, and four from Baltimore to Washington. Other lines are located in Massachusetts, Connecticut, New York, Pennsylvania, Ohio, Indiana and Illinois.

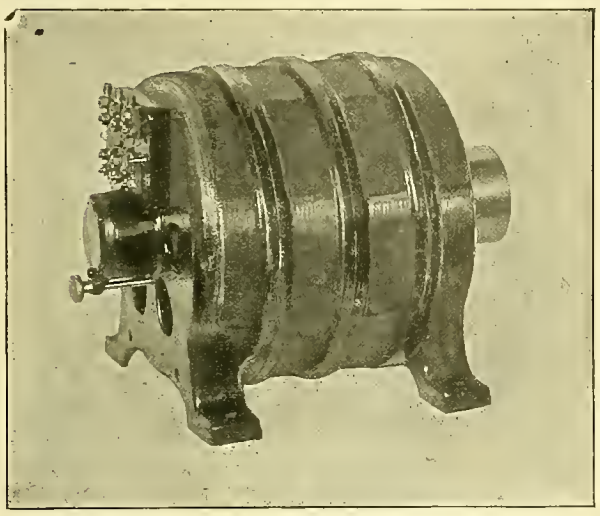
## Earnings of the North Chicago Street Railway.

The following interesting gossip is found in the financial columns of the *Chicago Herald* of October 26th:

There is the best authority for the statement that the North Chicago Street Railroad company will issue $1,000,000 additional stock about the beginning of next year. This will make the total amount outstanding $6,500,000. The earnings this year, in spite of hard times, have been unexpectedly heavy, and the connections which the company has made with various electric roads, together with its own electric lines, will in future, it is claimed, still further increase its earning power. So far this year North Chicago has earned at the rate of about 16 per cent. on its stock, and the management is inclined to think that its future is sufficiently well assured to justify the issue of more stock. This, it is thought, will be better policy than to increase the dividend rate. The stock will be sold at par and the proceeds used for electrical construction. It is stated further that the North Chicago surplus, accumulated from last years's World's Fair traffic, is still intact.

## Induction Motor of the General Electric Company.

A good example of the smaller line of induction motors which the General Electric company is placing upon the market is that known as the T. I. I. H. P. shown in the accompanying illustration. This motor has been designed to give a powerful starting effort without excessive current. It is almost completely enclosed and may be entirely so, if desired. It is totally without moving contacts and the only connection it has with the external circuit is through the binding posts on the outside of the motor. The armature has no connection with the external circuit. Inside of the armature is placed a resistance, only kept in circuit when the motor is first started. The plug shown on the side of the motor, under the bearing, short-circuits this resistance as soon as the armature has attained its speed. The motor is wound for 110 volts, and, owing to the simplicity of the winding and the low potential, burn-outs are almost impossible. The absence of commutator and collector rings obviates all danger of sparking and entails the minimum amount of attention in operation.



INDUCTION MOTOR OF THE GENERAL ELECTRIC COMPANY.

## The Knapp Failure.

Interest in the affairs of the Knapp Electrical Works, recently closed by the sheriff and for which a receiver was afterward appointed, continues to increase rather than diminish. As has already been stated in the WESTERN ELECTRICIAN, the dissatisfied creditors associated themselves together to push their claims and appointed an executive committee to act for them. The creditors who thus agreed to co-operate are:

John A. Roebling's Sons company, Perkins Electric Switch Manufacturing company, American Electrical Works, R. S. Thomas & Sons company, Bryant Electric company, R. R. McCabe & Co., New York Insulated Wire company, Sunbeam Lamp Manufacturing company, New England Butt company, Western Electric company, *Electrical Engineer*, H. T. Paiste, C. H. Lever Manufacturing company, Great Western Manufacturing company, Columbia Rubber Works company, Rice Machinery company, W. H. Sills, *Electrical Industries*, E. R. Crolius, Hart & Hegeman Manufacturing company, Turner Brass Works, Buckingham & Paulson, Chicago Edison company, Hadfield & Co., Chas. W. Tegtmeyer, George H. Benedict & Co., Sethness Chemical company, Fred P. Bagley & Co., Roth & Eck, Chicago Electric Protective company, Fuller & Fuller company, John M. Green Manufacturing company, Orient Manufacturing company, Holtzer-Cabot Electric company, Peckstow & Wilcox company, Manhattan Electric Supply company, Electric Power & Storage company, Electric Construction & Supply company, Alfred F. Moore, Steel & Johnson Manufacturing company, H. G. McFadden & Co., Electric Engineering & Supply company, Hammond Cleat & Insulator company, A. & J. M. Anderson, Albert Russell, Hapwell Manufacturing company, Bernstein Electric company, New York Carbon Works, Walworth & Neville Manufacturing company, Chas. H. Besley, H. M. Loud & Sons Lumber company, Edgerton Pottery company.

The executive committee consists of George S. Searing of the Hart & Hegeman company, James Wolff of the New York Insulated Wire company, Francis E. Donohoe of the American Electrical Works and Thomas G. Grier of the Bryant Electric company.

An expert auditor, E. F. Bard, was employed by the creditors' committee to examine the books of the Knapp Electrical Works and make a report on the condition of the business. That report, consisting of 186 pages, mostly typewritten, is now in. The tenor of it may be gathered from the following affidavit made by Mr. Bard and presented to Judge Tuttle last week:

Edmund F. Bard, being first duly sworn, on oath deposes and says that he is and has been for twenty-seven years last past a book-keeper, auditor, expert accountant and actuary; that for two years last past he has devoted his entire time and attention to auditing and making thorough examinations of the books, accounts and affairs of large corporations and firms engaged in various lines of business in the city of Chicago; that on the 24th day of September, A. D. 1894, he was retained by the executive committee of the Knapp Creditors' association to make a thorough examination and investigation of the books, papers, records and affairs of the Knapp Electrical Works, a corporation under and by virtue of the laws of the state of Illinois, and report thereon; that as this affiant is informed and believes the above mentioned books, papers, records and assets of the said Knapp Electrical Works were at that time in the custody and possession of one Harry P. Lucas, as receiver, at the former place of business of said corporation, viz., 271 and 273 Franklin street, in said city of Chicago; that in accordance with his instructions from said committee he thereupon and on said last mentioned date proceeded to make a thorough and exhaustive examination of all of the books, records, documents and other data obtainable by him from Lucas, receiver, M. A. Knapp, the president and general manager of said corporation, R. H. Watson, the cashier and general bookkeeper of said corporation, and W. B. Austin, one of the directors of said corporation.

That he continued such examination for a period of about seventeen days, and thereafter and on the 11th day of October he rendered a report to the said executive committee of the Knapp Creditors' association, consisting of 186 pages of written and typewritten matter, comprising a general report of the financial affairs of said Knapp Electrical Works from the date of its incorporation to September 1, 1894; also a general report of the financial affairs of the predecessor of said corporation, the Knapp Electrical Works unincorporated, and a detailed report of the receipts and disbursements of the present receiver from September 1, 1894, to October 4, 1894, inclusive. That all of the statements and exhibits therein contained are correct abstracts from the books, papers, records and other original data belonging to the Knapp Electrical Works examined by this affiant as aforesaid, except the calculations, estimates and percentages which therein appear to have been made by this affiant, and as to those he verily believes them to be correct. That the following facts and figures are some of the more important and noticeable items contained in said report, viz.:

The property turned over to the Knapp Electrical Works, incorporated, by F. M. Knapp, in payment for the $100,000 capital stock issued, was, as is shown by the minutes of the meeting of directors on February 4, 1890, represented by M. A. Knapp to be worth $108,750, whereas its actual value as shown by the books was $64,492.22, showing an apparent deficiency of $35,507.78.

The books show that the business has been constantly on the decrease since September 1, 1891; that for 18 months ending March 1, 1893, the net profits were only $4,112.50 on gross sales of merchandise amounting to $872,595.91; that the ratio of gross profits was 9 per cent. and expenses 8 per cent.; that for the following 18 months ending September 1, 1894, the percentage of gross profits decreased to 8 per cent., whereas the expenses increased to 16 per cent., and the net loss in conducting the business was $53,345.92; that the average monthly expenses during the 18 months ending March 1, 1893, on sales aggregating $872,595.91 was $3,737.20, whereas for the following 18 months on sales aggregating $515,724.91, or a little more than one-half, the monthly expenses averaged $4,134.22, or an increase of $400 per month.

According to the minutes of the board of directors, F. M. Knapp resigned the presidency of the company on September 12, 1893, and at the following meeting, September 18, 1893, a judgment note was given to him for $27,989.50.

Under the date from August 20 to 27, 1894, inclusive, the books show $24,359.64 in accounts receivable and $16,387.21 in bills receivable were transferred to sundry creditors, of which $7,263.85 in bills receivable signed by J. B. Whalen & Co. were transferred to F. M. Knapp. There was also transferred to him $3,283.43 in stock of the Hercules Iron Works, and credit was given him on the books for $1,000 for "expenses incurred by him up to August 25, 1894, in the way of legal advice, railroad fares, traveling expenses, etc." The ledger showed him indebted to the company on open account on September 1, 1894, the sum of $325.08.

Stock of the Commercial Electric company of St. Louis, Mo., amounting to $2,500 was transferred to M. A. Knapp. His account was credited with $6,000 on salary account, of which $1,333.36 represents an increase in rate dated back to March 1, 1893. His account was also credited with $962.50 for traveling expenses and $1,200 for entertainment expenses.

During the same period the books show the purchase of $8,400 in second mortgage bonds of the Cicero Light, Heat & Power company from H. P. Lucas, the present receiver; the sale to him of one 2,500 light dynamo for $2,800 and $2,584.97 in merchandise on account, and the ledger shows a balance due from him September 1, 1894, of $448.34.

That among the bills receivable shown upon the books of said corporation are the following notes given by H. P. Lucas to said Knapp Electrical Works:

| *Date.* | *Amount.* | *Due.* |
|---|---|---|
| June 9, 1894 | $2,031.00 | Sept. 12, 1894. |
| " 15, 1894 | 1,015.50 | " 18, 1894. |
| " 23, 1894 | 812.40 | " 26, 1894. |
| " 25, 1894 | 1,015.50 | " 28, 1894. |
| " 29, 1894 | 560.70 | Oct. 2, 1894. |
| Aug. 18, 1894 | 354.19 | " 20, 1894. |
| " 18, 1894 | 355.94 | Nov. 19, 1894. |

All of which were outstanding and unpaid on September 1, 1894.

The books show an indebtedness of J. B. Whalen & Co. of $12,304.14 closed out by the alleged return of $3,500 in tools and machinery and $2,864.43 in merchandise, and the giving of $5,939.71 in notes which were transferred to F. M. Knapp.

That the following is a true and correct abstract of the receipts and disbursements of the said receiver as appears by his books from September 1, 1894, to October 4, 1894, inclusive:

| | |
|---|---|
| Weekly pay rolls (4 weeks) | $1,388.99 |
| Stationery, etc | 20.33 |
| Teaming, cartage, express and freight | 75.38 |
| Packing cases, boxes, hay, etc | 24.45 |
| Postage, postal cards, notices, etc | 27.98 |
| Telegrams | .50 |
| Entertaining (E. R. Crolius) | 9.20 |
| Hauling rubbish | 3.00 |
| Gas | 12.48 |
| Material for shop | 232.56 |
| H. P. Lucas, receiver | 344.90 |
| M. A. Knapp | 316.64 |
| G. L. Marchond company (expert accountant) | 127.50 |
| Brads, pins, tacks and miscellaneous items | 7.73 |
| Sheriff's fees | 80.00 |
| Insurance | 166.40 |
| F. M. Knapp (summons in Harris case) | 12.00 |
| Total for September | $2,790.04 |

*October 1st to 4th, inclusive.*

| | |
|---|---|
| Stationery, etc. (total since Sept. 1, $20.93) | .60 |
| M. A. Knapp (total since Sept. 1, $437.17) | 120.53 |
| Material for shop (total since Sept. 1, $409 21) | 176.65 |
| Cartage, teaming, freight, etc. (total since Sept. 1, $84.64) | 9.26 |
| Packing cases, boxes, etc. (total since Sept. 1, $34 25) | 9 50 |
| Rent | 466 67 |
| | $783 51 |

This affidavit forms a part of the proceedings in Judge Tuttle's court on October 26th, when the creditors' committee, through its attorneys, endeavored to have the appointment of the receiver set aside, on the ground that it was unsatisfactory to many of the creditors and also because Mr. Lucas was a debtor to the company. The judge denied the application, but stated that if three-fourths of the creditors would sign a petition to that effect he would remove the present receiver. The dissatisfied creditors are now endeavoring to obtain the necessary signatures.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, October 29.—A petition from the Niagara Falls Power company asking for a grant to put wires through Buffalo for the distribution of electric power was transmitted to the board of aldermen in that city on October 22d. The petition bears a peculiar interest, because it is the first official step in Buffalo in an enterprise which, it is believed, will multiply the industries of Buffalo.

C. E. Warren, secretary of the Metropolitan Traction company, has issued a statement of the company's condition on October 1, 1894, which shows capital stock issued, $27,301,650; net cash in bank and due in open accounts from other companies, $3,362,532; balance represented by investments in stocks and bonds of other companies controlled and owned by the Metropolitan Traction company, $23,939,018; total, $27,301,650. The Metropolitan street railroad alone is earning 5 per cent. on investments. The company owns the Columbus and Ninth avenue cable road, the Lexington avenue cable road and the Lenox avenue underground electric road. The Columbus avenue road will, it is said, be operated as a through cable road by November 15th in connection with the Broadway road. Both the Lexington avenue and the Lenox avenue roads are being built and will probably be finished before the first of the year. When the lines are completed the company will own and control 143 miles of road. The 120 miles in operation show an increase in net earnings for September last over September, 1893, of over $50,000. The bonds and stocks of these companies in the treasury of the Metropolitan Traction company are Columbus and Ninth avenue first mortgage 5 per cent. bonds, $3,000,000; Columbus and Ninth avenue capital stock, $3,000,000; Lexington avenue & Pavonia Ferry Railroad company's first mortgage 5 per cent. bonds, $5,000,000, and $5,000,000 capital stock of the same company, making a total of $16,000,000.

An action against the Brooklyn Heights and Brooklyn City Railroad companies for an accounting and the division of a $700,000 surplus has been begun by Patrick H. Flynn, a stockholder in the Brooklyn City company. The suit is to have the expenditure of the surplus adjudged unlawful and to restrain the pledging or the selling of the property of the Brooklyn City road, and also to adjudge the expenditure of money by the Brooklyn Heights company excessive and fraudulent. Mr. Flynn alleges that the persons who engineered the big deal by which the Brooklyn City was leased

to the Brooklyn Heights company were in a scheme to get control of the former company and to divert a part of its earnings into their own pockets. They first got control of the Heights road, which is capitalized at only $220,000, and then had the Brooklyn City road leased to it. The next step was the equipment of the City road with the trolley, spending all the money raised by the City company and the additional surplus of $700,000. Mr. Flynn alleges that contracts at fraudulent and improper prices were entered into with corporations in which the defendants were stockholders and directors. The money, as charged, was so improperly expended that there was not enough to finish the equipment, and for this purpose it was arranged to issue trust notes of the Brooklyn Heights company for $3,000,000, and to secure these notes it was intended to pledge the property of the City road. W. F. O.

## Milwaukee, Wis.

MILWAUKEE, October 27.—General Manager Wyman of the Milwaukee Street Railway company recently appeared before the Board of Public Works on a request to furnish power to open the big draw of the Holton street viaduct. The viaduct to-day was formally turned over to the city. So far the draw has been opened by electric motors, the street railway company furnishing the power. The city has purchased two 25 horse power motors, and found that it will cost $2 per day for power from the company. At the other bridges which are operated by electricity the power is furnished by the company free of charge, but this, Mr. Wyman stated, the company could not do where it did not run its cars over the bridge. Nothing was said at the meeting about running cars over the viaduct, but it is probable that this will follow, inasmuch as it will save the city about $700 per annum, beside ridding Island avenue residents of what they consider a great nuisance, the running of the cars up Island avenue. Now that there is another way of crossing the river, people along the hill are moving to have the company take up its tracks on Island avenue. There is always great danger at the railroad crossing, it is claimed, and in case of a brake giving out, or of an unmanageable motor, the car could never make the turn at the foot of the hill safely. Added to this, cars are delayed daily owing to the great amount of switching across the streets.

General Manager Wyman, speaking of the matter, said that the company was not especially anxious to run over the Holton street bridge. To do this the company would have to lay quite a bit of extra track, and then it would be expected to tear up its tracks and take down the poles and wires on Harmon street and Island avenue.

The Board of Public Works has asked the Milwaukee Arc Light company, the Edison Lighting company, the Badger Illuminating company and Capt. Pabst, who has a large power house, for information regarding the lighting and heating of the new city hall. Provision has been made for an electric elevator. In case the whole building is lighted with electric lights, it will require 4,000 incandescent lamps of 16 candle power each. In addition it will require two arc lights of 2,000 candle power for each of the East Water, Biddle and Market street entrances, and one arc light to main entrance in tower of 4,000 candle power. Provision is to be made for the amount of light used to be measured by a meter. It was proposed to put up a lighting and heating plant at some distance from the building, but the council killed that measure long ago, so that if no chimney were put into that building, as was recently proposed, the city, it is claimed, would be at the mercy of the lighting and heating corporations, who would furnish the power at their own figures. It would save only $4,000 on the cost of the building to omit the chimney and would result in a considerable loss in the future. Hence the chimney will be built. Architect Koch says that he simply suggested the matter to the city officials, with the idea of allowing them to do as they saw fit. He asserts that if the lighting and heating apparatus is placed in the basement, as contemplated, it will certainly result in damage to the building. The continual operation of the machinery will cause a vibration of the entire building, which will injure it in time and make it very disagreeable for the occupants. C.

## Northwestern Notations.

MINNEAPOLIS, October 27.—The Custer axle grease factory, at Custer City, S. D., is progressing, and machinery is arriving. It is hoped to have it in operation by December. The factory will turn out mica for electrical purposes and supply arc and incandescent lights for the city in addition to its regular product.

The Manhattan Beach company is making improvements at Lake Manawa, to cost $10,000, in anticipation of the Council Bluffs, Ia., and Lake Manawa electric street railway line being built in time for the summer season.

An electric railway is proposed from Hot Springs, S. D., to the famous wind cave, and a franchise will be asked of the council. If it is granted work will be begun at once. The company will utilize water power near the cave to furnish power and to light the cave. It is understood that New York capitalists are backing the electric railway.

The electric light plants of Faribault and Owatonna, Minn., have been consolidated under one management, and George F. Hewes, formerly manager of the Faribault plant, becomes the manager.

There is some dissatisfaction over the slow way the holder of the electric light franchise at Grand Rapids, Minn., acts, and it has been suggested that arrangements be made with the Zenith Electric company of Duluth if something is not done soon.

Representatives of the Harrison International Telephone company are seeking to place exchanges in Davenport, Ia., and Rock Island, Ill., and have received sufficient encouragement to state positively that they will be put in. This company is actively working in Iowa and is meeting with success. The company now has systems in operation at Decatur and Carlinville, Ill.; Topeka, Kas., and Lafayette, Ind., and one is being put in at La Crosse, Wis.

The city council of Albert Lea, Minn., has voted a special tax of $3,000 for an electric light plant.

Citizens of Calmar, Ia., are discussing the advisability of the town putting in an electric light plant.

Clark & Bonwell are negotiating with the council of Winnebago City, Minn., to put in an electric lighting system with 40 lights. This firm has just completed a plant in Blue Earth City, Minn.

The Harrison Telephone company has organized a company at Sioux City, Ia., to put in an exchange, and has secured contracts with nearly all the old company's subscribers for five years. It has cut rates in half. Work will be begun on the system at once.

W. J. Bell, an electrician of Winona, Minn., secured the contract for putting in an electric light plant at Durand, Wis., and will begin work immediately.

E. E. Hazen, Jacob Kiefer, P. H. Lamb and other well known citizens of Moorhead, Minn., are understood to be interested in a company which will shortly ask for an electric light franchise.

The council of Minneapolis, Minn., has passed a resolution to submit to the voters a proposition to issue $300,000 of bonds to put in an electric lighting plant. It will be voted on at the November election.

The International Electric company of Minneapolis, which operates the plant in the Edison building, will soon make important additions to its plant. Its business has been increasing rapidly, making an enlargement of capacity absolutely imperative.

A home company has been formed at Fort Dodge, Ia., for a telephone exchange and the promoters have secured 90 per cent. of the Bell company's subscribers.

An interurban electric railway is proposed to connect Oshkosh, Appleton, Kaukauna, Menasha and Neenah, Wis. A franchise has been secured through Oshkosh and Appleton, and Kaukauna will probably grant it, but merchants of Menasha and Neenah oppose granting one on account of the increased competition.

The Harrison International Telephone company will establish a telephone exchange in Des Moines, Ia.

J. E. Erickson of St. Paul, Minn., will remove to Grantsburg, Wis., and supply the city with electric light in connection with his factory.

The Badger Telephone company of Poysippi, Wis., has organized with $2,000 capital stock and will build a line to Berlin, Wis. This will give it a line from Berlin to Waupaca direct.

West Union, Ia., has voted to put in electric lights.

The contest between the electric light company and the town of Marion, Ia., has been compromised at $75 for 40 1,200 candle power lights, $65 for 50 lights and more than 50 lights for $60.

Henderson, Minn., has succeeded in disposing of its electric light bonds and will begin work at once on a power house.

The Polar Star Electric company of Faribault, Minn., has filed articles of incorporation with $50,000 capital stock. J. Hunter, R. Weatherstone and J. F. Hughes are the incorporators.

A new telephone company has been formed at La Crosse, Wis., and is soliciting subscribers at $30 per year for business houses and $18 for residences, with the understanding that if enough subscribers cannot be secured to make the venture pay, a higher rate shall be charged.

The Minneapolis General Electric company of Minneapolis, Minn., has taken out a permit to erect its two-story electric light station on Main street southeast, between Second and Third avenues, to cost $20,000.

Charles D. Braun, of the Braun Electrical Supply company, Minneapolis, has invented an electrical heater, the heat coming from a common incandescent current running through a few coils of annealed iron wire, which are inclosed in a large drum. It gives an intense heat and is very simple in operation. It will be of great value for steam fire engines, as by turning a button the coils will be heated and in a short time the water in the boiler be boiling. It can be utilized to heat cars by running an incandescent wire through a small pipe the full length of the car and a uniform heat will result. N. L. P.

## PERSONAL.

William H. McKinlock, president of the Metropolitan Electric company, Chicago, is in New York.

Frederick W. Davis, secretary of the Perkins Electric Switch Manufacturing company of Hartford, Conn., is in Chicago.

Charles M. Proctor, manager and vice-president of the Proctor-Raymond Electric company of Rochester, N. Y., was in Chicago last week.

Secretary and Treasurer R. V. Scudder of the Western Electrical Supply company, St. Louis, spent Friday last in Chicago. Mr. Scudder was on a hurried trip and returned home in the evening.

Charles Blizard of the Electric Storage Battery company of Philadelphia was married in Chicago, on October 23d, to Daisy May Hibbard. Mr. Blizard is widely known among electrical men in both the East and West through his connection with his present company. The newly married couple will reside in Passaic, N. J.

George G. Carter, well known to the electrical fraternity of Chicago and the West through his connection with the Ansonia Electric company and the firm of George G. Carter & Co., has returned from Mexico. Mr. Carter is now interested in the Tampico Land & Commercial company of Chicago, which is capitalized at $1,000,000 and has obtained a large concession of coffee lands from the Mexican government.

## ELECTRIC RAILWAYS.

Greenville, Texas, is to have an electric street railway, a franchise having been recently granted. The mayor can furnish full particulars.

Steps have been taken toward building an electric road between Chicago and Joliet, Ill. The ground, it is said, has been looked over by prominent capitalists. R. B. Campbell, general manager of the Baltimore and Ohio Railroad company, and President Baker of the Trust & Savings company are mentioned in connection with the scheme.

The firm of Siemens & Halske, supported financially by the Anglo-Bank, has submitted to the Austrian Ministry of Commerce a project for an electrical underground railroad in the city of Vienna. The plan is to have a flat top tunnel immediately under the pavement and not deep in the soil, the height underneath the deck to be only 8 feet 10 inches. The current is to pass over the cars and the return current through the rails. The cars are to seat 40 passengers, with doors automatically locked when in motion, while the train cannot be started till the doors are closed. The machinery is on the top of the car. The project is for a double-track road of standard gauge. The speed promised is nearly three times as great as that of the existing street railroad systems.

Application has been made to the public service committee of the County Board, Chicago, by a new corporation known as the Chicago Suburban Rapid Transit company for a franchise authorizing the construction of an electric street railway in the northwestern part of the city. The route of the promised line commences at Fullerton avenue and West Seventy-second street, running thence north along Seventy-second street to Tanner road; thence northwesterly along Tanner road to the street known as Dee road; thence along Dee road to Center street; thence west on Center street to the River road; thence northwest along the River road to Jefferson road; thence along Jefferson road to the Lee road; and thence northerly to the southern corporate limits of the village of Desplaines. It is proposed that a branch connecting at Higgins road and the western limits of the city be run northwesterly along Higgins road to the western limits of the town of Maine.

A ground electric system for street car propulsion was given a trial on a short stretch of track near the Rouge river at Detroit, October 24th, and seemed to work well. It is the invention of Thomas Harris, a Detroit man, and Detroit and Hamilton, Ont., people are behind it. Between the ordinary rails was a third rail laid in car lengths, first on one side and then on the other, and insulated from the ground. There was no electrical connection between them. Small boxes containing six electro-magnets are distributed along the line. To each of the iron boxes a feeder wire runs, and by means of the magnets the current is distributed to the rails and to the motor in the car. The motor propels the car over the rails by reason of the contact of the brushes with the charged rails. When the brushes leave the sections of rail and the car passes to the next the current shifts from the first magnet and automatically passes into the second. When this takes place the armature, falling by gravity, opens the circuit, leaving the rails passed without any current. At the same instant the second magnet picks up its armature and closes another circuit, which gives the current to the next pair of rails to which the car has just passed. As the car rolls along the current passes with it, being shifted from rail to rail by the magnetic action. Fair speed was attained, and the car moved either forward or backward at the will of the operator.

The West End Street Railway company of Boston is making preparations to put its entire system of feeder wires underground. This is in compliance with the law com-

pelling the company to place all its feed wires north of Dover and Berkeley streets underground in six years. The law requires that before January 1, 1895, 200,000 feet of conduit and 21 miles of feeder cable shall have been placed underground in the district bounded by Dover street, Shawmut avenue, Tremont, Boylston and Essex streets and Fort Point channel, and work is now in progress to this end. The total cost of taking down the present overhead wires and placing them in conduits, including cost of conduit, etc., will average about $6,000 per mile per wire. The number of wires to be buried varies according to distance from the power house and the varying amounts of current needed at various points, from 34 wires at the Albany street power house, down to two or one. There are eight now being laid in Bolyston street. It will require about 40 miles of conduit to accommodate the 60 miles of feed cables north of Dover and Berkeley streets, and will call for an expenditure of about $360,000. Ultimately the conduct will be extended to the East Cambridge power house.

That the trolley is making rapid progress in and about Philadelphia is shown by the following extract from the Philadelphia *Record*: "While the various traction companies in this city are rapidly pushing forward to completion the trolley on their various lines of railroad, the suburban districts are keeping pace with them. The time is not very far distant when the trolley to Norristown, Ambler, Conshohocken and other points in Montgomery county will be an accomplished fact. Work upon the trolley line from Norristown to Barren Hill has been resumed by Contractor Dyur. The line had already been completed as far as the Trenton Cut-off, and from there to Conshohocken it is now being built. Mr. Dyur, who has the contract for the entire line to Barren Hill, expects to have it completed by January. Permission having been granted by the town council of Ambler to build the trolley through its streets, the Shepp Brothers of this city, who are prime movers in the building of the line from Norristown to Barren Hill, have determined upon branching off from that line at or near Harmonyville, and extending it to Ambler. The People's Traction company, which has determined to extend its line from Chestnut Hill out the Bethlehem pike to Penllyn and Spring House, has not as yet asked permission to build through the streets of Ambler; but the citizens of that town are prepared to welcome it with open arms. With the proposed extension of the Pottstown line southward from its present terminus at Sanatoga Park to Royersford, and the strong probability that the Norristown company will extend to either Spring City or Royersford, there are strong indications that before very long a trolley car can be taken at Eighth and Chestnut streets, Philadelphia, and by a system of exchanges, the Schuylkill Valley can be traveled over by trolley as far west as Pottstown, 40 miles distant. The business of the People's Traction company since the completion of its trolley line to Germantown has been very largely augmented by the numerous trolley parties which nightly travel over the line. On Thursday night there were 40 of these parties on the line, and 20 on Friday night. It is considered a very slow night when there are not as least 10 or 12 of these parties riding over the road. President Moore of the company said yesterday that the Girard avenue branch of the company's trolley system would be put into operation in two weeks. The delay in operating the line, he says, is due entirely to the failure of the company to secure cars. The work upon the extension of the system to Willow Grove, over the old York road, by the Philadelphia, Cheltenham & Jenkintown Passenger Railway company, an allied corporation, is being pushed forward rapidly. The tracks have already been laid to Hunting Park."

## TELEPHONE.

The Southern Telephone company of Bennettsville, S. C., has just completed the construction of a telephone line from Dobson to Mt. Airy, N. C.

Direct telephone connection between Berlin and Bremen, Cologne and Hamburg was established October 1st. The charge for a three-minute conversation is 25 cents.

Arthur E. Davies, manager of the Central Union Telephone company's office at Michigan City, Ind., is reported to have absconded with $565 of the company's funds.

The completion of the main artery of the Farmers' Telephone company's lines into Massillon, O., has raised an issue involving the rights of telephone subscribers. The new competing company, using Harrison instruments, advertises that messages will be received at its terminal station in Massillon through the old, or Bell, instruments and transmitted by an operator over its own lines. The Central Union company, which controls the Bell exchange at Massillon, contends that it has the right to refuse to permit messages to go over its wires for transmission by a rival system, and the removal of the Bell instrument from the Farmers' terminal station is threatened. The Farmers' people say that, having leased a Bell instrument, no one can be the judge of what matter they choose to receive.

## TELEGRAPH.

The Missouri District Telegraph company, an auxiliary of the Western Union Telegraph company, began business in St. Louis last week. The object of the new company is mainly to deliver Western Union business, but it will also do a general district telegraph and messenger business. An auxiliary company being engaged in the delivery business is enabled to employ a larger number of messengers, and thus give better delivery service than the telegraph company could give.

Judge Ross, in the United States Circuit Court at Los Angeles, Cal., has decided favorably the application of the Postal Telegraph-cable company to be accorded facilities by the receivers of the Atlantic & Pacific Railway company for constructing its telegraph lines along that road. In deciding the matter Judge Ross filed quite an elaborate opinion, in which he holds that the contract of the Western Union Telegraph company with the railroad for exclusive powers is not valid. The ruling of the court upon the questions raised is regarded as one of more than usual importance.

## ELECTRIC MINING.

The State Department at Harrisburg, Pa., has granted letters of incorporation to the Scranton Electric Construction company with a capital stock of $15,000. The company comprises William T. Smith, Orlando S. Johnson, Edward B. Sturges, Frederick J. Platt, F. E. Platt, Scranton, and Joseph C. Platt of Waterford, N. Y. William T. Smith is the president and F. J. Platt is the general manager. The purpose of the company is to install electric plants for the lighting, drilling, haulage and dumping or any other form of electrical application in or about mines.

## POWER TRANSMISSION.

The power and mining department of the General Electric company has closed a contract with the Sacramento Electric Light & Power company, Sacramento, Cal., that calls for the transmission by electricity from a water power at Folsom, Cal., twenty miles distant, of several thousand horsepower to the city of Sacramento to supply light, heat, power, etc., to an extent that will practically supersede all the present steam plants in operation.

One of the most important corporations which have been chartered in West Virginia for years was granted a certificate last month. It is the Great Kanawha Falls Water Power Electrical Manufacturing & Land company. The company is capitalized at $2,000,000, and the principal stockholders are: Charles M. Reed of Baltimore, Md; A. McClintock, of Philadelphia and A. O. Patton, W. W. Tompkins, W. F. Scott, T. F. Snyder and M. Levi of Charleston, W. Va. It is proposed to build an electrical plant at the Great Kanawha Falls. This power is to be transmitted to mines, factories and railroads and furnished the various towns for street and commercial lighting. Another part of the scheme is to erect trolley wires along the channel of the river, one on each side, for the use of boats towing coal from the mines through the pools.

B. H. Thwaite and James Swinburne have submitted to the Manchester Association of Engineers a plan for transmitting power from the South Yorkshire coal fields to London, with trunk lines for serving the large towns along the line of transmission, including Derby, Nottingham, Leicester, Northampton, Bedford, etc., and possibly an auxiliary station in South Staffordshire for the service of Wolverhampton, Birmingham and the industrial areas in the line of its route across to the point where it joins the main trunk line serving the metropolis. The plan is to generate power by burning coal at the pit's mouth, and to transmit the power electrically. The coal will first have its "residual products" removed. As these form the most valuable portion of the coal, the fuel actually used may be itself fairly regarded as the residual product of the distillation. Gas engines are to be employed instead of steam engines and boilers, and the power is to be transmitted by high pressure alternating currents, it is said.

An installation of the electrical transmission of power from Pale to Foligno, Italy, is now being carried out, this being the first plant of its kind in Italy where polyphase currents will be used, asserts the *Electrical Engineer*, London. The power will be obtained from the Menatre, in the proximity of Pale, and the water will be conveyed to the turbines at the generating station in Pale by means of a canal and conduits. There will be installed three turbines, each of 100 horse power and each coupled directly from its horizontal shaft to a polyphase generator giving current at 2,000 volts. The length of the primary conductors, which are divided into two circuits, is 4.34 miles. One of these circuits will energize transformers for the supply of current for lighting purposes, and the other for motive power. The distributing station is situated in the center of Foligno. From here the high pressure current will pass to nine transformer stations, where the current will be distributed to consumers. The electrical plant emanates from the Oerlikon Maschinenfabrik and the turbines from the Società Italo-Svizzera of Bologna.

## MISCELLANEOUS.

The programme of the lecture course to be given under the auspices of the Chicago Electrical association shows that some well-known local electrical men will contribute lectures. Among them are Alfred L. Têtu, city manager of the Chicago Telephone company; George S. Iredell and J. J. O'Connell of the same company, Messrs. Baldwin, Prince, Larned, Fowler, Waite, Abbott, Millikin, Rhodes, Edson, McMean and others. This series is of a very interesting character and will undoubtedly be well supported.

An interesting photograph of a sextuple lightning flash was exhibited at a recent séance of the French Academy. The negative was taken by a Steinheil detective camera placed in a window during a terrific thunder storm which broke over Prague on May 22d of this year. The flash struck four houses simultaneously, wrecking the roofs and doing considerable damage. Two other flashes are distinctly shown in the photograph as darting out from the same cloud, one of which struck the cupola of the Academy of Science without injuring it, while the other was attracted by a group of telephone wires which it fused. The melting of the wire and the brilliant lighting up of the cloud are well shown. Another interesting and probably unique feature of this lightning photograph is that it shows the shadows of the cupola thrown clearly against the dark and cloudy sky. M. Zenger was of the opinion that the date of this storm was significant and that the interval from May 20th to May 22d being the days of the solar period, was frequently marked by storms, proving the periodicity of atmospheric disturbances, both electric and magnetic.

## TRADE NEWS.

The H. W. Johns Manufacturing company has issued a handsomely illustrated book showing installations of its asbestos covering. The pictures are of a particularly meritorious character and the book is certainly worthy of examination.

A postal card addressed to the Washington Electric company, 207 S. Canal street, Chicago, will result in securing something of interest to those engaged in the electrical industry.

"Cutters," issued by the Brown & Sharpe manufacturing company, Providence, R. I., is an extremely well illustrated book and one in wich the talking is done by the illustrations, for little reading matter is contained. The superior quality of the pictures justifies the company in this policy.

The Link-belt Machinery company of Chicago has issued a very handsome booklet entitled "Modern Methods of Handling Fuel, as Practiced in Locomotive Coaling Stations, Electric Light and Street Railway Power Plants." The publication is finely illustrated and reflects much credit on O. W. Russell, the advertising manager of the company.

William N. Famous, representing J. Grant High & Co. of Philadelphia visited Chicago last week. Mr. Famous had just come from the South and is finishing a western trip before returning to Philadelphia. He reports prospects for western and middle states trade as being beyond his expectations; in fact, his company's recent decision to start a branch office in Chicago is significant of its confidence in the amount of business to be obtained in the western territory.

## BUSINESS.

W. H. Bartholomew has assumed the management of the photo-engraving department of Bartlett & Co., New York. Mr. Bartholomew's work has attracted much attention and the productions of Bartlett & Co. are well known to the electrical trade.

The H. W. Johns Manufacturing company some time since received a flattering testimonial letter from the chief engineer of the United States navy, speaking in the highest terms of the asbestos covering which the company furnished several of the government cruisers.

Secretary and Treasurer J. Frank Stevens of the La Roche Electric Works, Philadelphia, visited Chicago last week. Mr. Stevens was much pleased with the prospects for western business and returned home expressing himself as surprised with the rapid growth of the electrical business in the West.

D. E. Boswell & Co., 154 Lake street, Chicago, are calling attention to their portable storage batteries for phonographs, electric launches, dental, surgical and medical work, electric lighting, etc. The batteries of 150 ampere hours' capacity, as well as other sizes, are put up in hardwood cases, with brass binding posts.

The Bryant Electric company has received a number of favorable comments upon the latest of its devices, the Bryant chandelier switch. While the demand for this article may be limited, the necessity for a device of its kind has been sufficient to make it a staple article, and it may be found in stock in almost every first-class supply house.

The Metropolitan Electric company, Chicago, has added another specialty to its list which should attract considerable attention and excite general interest. It is to handle the general line of electric cooking and heating utensils of the Western Electric Heating company. The Metropolitan Electric company will carry a full line of these goods in stock at its store on Fifth avenue. The goods manufactured by the Western Electric Heating company are novel and built upon correct principles.

The Central Electric company is receiving reports from the Falk trolley heads which are very gratifying, one trolley having made a record of 10,000 miles without showing any appreciable wear and another having been in constant service from September 4th to October 27th and showing apparently no wear. These records have been made upon two of the largest street railway systems in Chicago. The Central Electric company has an order for 100 of these trolley heads to be shipped to California.

The Electric Appliance company, Chicago, is having a nice run on its Acme expanding wire guard. This is a specialty of which the Electric Appliance company is the exclusive manufacturer and is one of the most satisfactory wire guards for the protection of incandescent lamps from mechanical injury that has ever been devised, as it automatically clamps the socket without the use of a holder of any kind and at the same time is neat and graceful in appearance.

The well-known firm of J. Grant High & Co., manufacturers of switchboards and switches, 123 North Third street, Philadelphia, Pa., has located a western office in Chicago, 807 Medinah building. J. Grant High & Co. have achieved quite a reputation in the East in their particular line; in starting their western department they make a special point of the fact that they can furnish estimates promptly on any sized switchboard, from the smallest to the largest manufactured. This concern makes nothing else but this one line of specialties, and the factory is equipped with special machinery through which high-class work can be quickly turned out.

The Paragon Insulating company, Cleveland, O., has been organized to enter the electrical world with a first-class product. The Acme insulating paint is placed upon the market after the most thorough test of its merits. The company has for a long time persistently devoted time and money to attaining the paint and asphaltuk which it is now introducing to its prospective customers, for it recognizes that there is in the electrical field a demand for a paint which is a good insulator, which without doubt dries quickly, which is acid-proof, which not only leaves a good black finish, but penetrates the molding and fabric upon which it is put and has an elastic consistency. The paint has withstood severe tests, and the company starts out with good prospects of success

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued October 23, 1894.*

527,766. Metal Brush for Dynamos. Wilhelm Vom, Braucke, Thmerterbach, Germany. Application filed July 2, 1894.

The brush consists of thin wires or threads of copper or copper alloys which are not twisted but loosely laid side by side. To combine these threads with each other and to hold them together they are inclosed or wrapped in a tissue consisting of a tresswork made of fine metal wire, which may be stitched together by silk threads or the like. Any optional number of copper wires may be laid side by side according as it is intended to manufacture a more or less large brush. The electric current flows, of course, in the longitudinal direction through the brush.

527,776. Electric Motor or Dynamo. Cornelius F. Daniels, Macon, Ga. Application filed December 2, 1891.

The devi e consists of a number of separate and independent field magnets, each magnet being made up of two parts, one forming the positive and the other the negative pole of the magnet, the positive pole of one magnet adjoining the negative pole of the next magnet, and so on around the entire circle.

527,785. Rail Bond. William A. Grauten, Hartford, Conn. Application filed June 7, 1894.

The inventor claims a rail bond consisting of a body having a turned or threaded shank with a hollow end, and with a plural number of wire grooves, the outer walls of the wire grooves being formed by outward extending ears and a bonding and a supplementary wire grasped by the ears.

527,786. Self-winding Electric Clock. Emil G. Hammer, Brooklyn, N. Y. Application filed July 18, 1893.

Instead of using an electric motor for winding up the spring or weight by a rotative action, the invention provides an electric vibrator or rheotome which is set in vibration at proper intervals, and which operates through the medium of a pawl and ratchet to effect the requisite rotary motion for winding up the spring or weight.

527,826. Carbon for Electric Lights. Edward G. Acheson, Monongahela City, Pa. Application filed August 25, 1894.

A carbon rod, point or filament for electric lamps is described, comprising carbide of silicon as an illuminating body, associated with a body of relatively high electrical conductivity, as carbon

527,839. Annunciator Signal. Isaiah H. Farnham, Wellesley, Mass. Application filed February 23, 1894.

The invention comprises the association with a telephone switchboard and its concomitant call annunciators of means actuated by the operation of annunciators for notifying the operator when any call remains unanswered, or has not received prompt attention, and for repeating such notification at suitable intervals until the call is duly responded to, and until the annunciator giving such call has been reset.

527,840. Support for Trolley Wires. Frederick C. Fisk, Buffalo, N. Y. Application filed March 1, 1894.

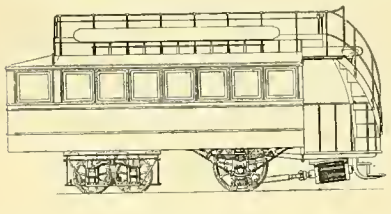
This invention consists of twin parts adapted to be riveted together, and having in their contacting inner faces similar inclined grooves which register with each other to form an inclined passage extending entirely through their length, and a sleeve adapted to surround and carry the line wire and provided with inclined flanged wings adapted when brought together for sliding and wedging engagement with the inclined passage between the twin parts, the whole adapted to be secured to an insulating bell.

527,857. Transformer System for Electric Railways. Maurice Hutin and Maurice Leblanc, Paris, France. Application filed November 16, 1892.

A system of electric traction is described, consisting in the combination of the vehicle to be driven, a stationary primary circuit extending longitudinally of its travel and carrying alternating currents of high frequency, and a secondary circuit carried on the vehicle and including a secondary coil within inductive proximity to the primary circuit, a means for suppressing the self-induction of the coil, a motor and a laminated iron core for the secondary coil extended beyond the latter into closer inductive proximity to the stationary primary circuit.

527,861. Method of Manufacturing Elements or Plates for Secondary Batteries. Hugh F. Kirkpatrick-Picard and Henry Thame, London, England. Application filed January 10, 1894.

To carry the invention into effect the inventors use a metallic mold, of which the internal walls are first lubricated by some suitable material, such as talc, chalk or graphite. The method consists of melting separately galena and metallic lead, mixing it and pouring the mixture in a molten condition into the heated metallic mold.



NO. 527,857.

527,864. Carbon Holder for Arc Lamps. Erwin Lavens, Brooklyn, N. Y. Application filed March 17, 1894.

In a carbon holder the combination is described of a plate having an angular portion, another plate also made angular and fitted to the first so as to be capable of sliding lengthwise relatively thereto, and means for adjusting the plates relatively to each other.

527,873. Closed Conduit Electric Railway. James F. McLaughlin, Philadelphia, Pa. Application filed April 5, 1894.

An electric railway is described, having a closed conduit provided with a central exposed conductor and an interior main or supply conductor, a traveling electro-magnet straddling the exposed conductor and a trolley in the conduit for establishing the circuit between the main and exposed conductors, and carrying an armature in operative relation to the magnet.

527,874. Closed Conduit Electric Railway. James F. McLaughlin, Philadelphia, Pa. Application filed May 24, 1894.

The present invention relates more particularly to the means for suspending operating electro-magnets on a motor car, and its object is to provide a mounting for the magnets by which they may be placed close to the surface of the roadbed, and at the same time be free to adapt themselves to any undulations of or obstruction upon the roadbed, and to deviations from parallelism between the rails and the conduits.

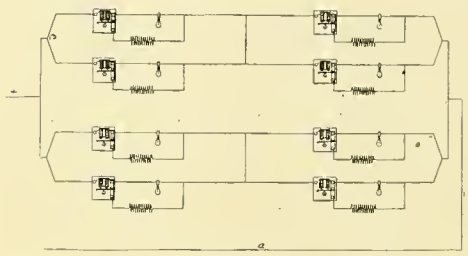
527,901. Electric Arc Lamp. Hans O. Swoboda, New York, N. Y. Application filed March 2, 1894.

Claim 1 reads:

In an arc lamp, the combination of a movable carbon support, a rotary part connected with such support, a tilting frame, a solenoid or magnet for controlling the movement of the tilting frame, an escapement, escapement wheel and balance lever carried by said tilting frame, said escapement having a laterally projecting pin, mechanism under the control of the escapement carried by said tilting frame and having a pawl and ratchet connection with said rotary part, a fixed frame, and an arm extending therefrom provided with a laterally projecting arc-shaped flange at one end, which co-acts with the pin of said escapement to prevent movement of the latter in such a manner as not to interfere with the movement of the tilting frame.

527,920. Trolley Wire Support. Montraville M. Wood, Chicago, Ill. Application filed April 30, 1894.

There is described the combination in a trolley support of a bracket arm, a span wire support attached to the end or the bracket arm an eyebolt or the like passing through one end of the span wire support, and a flexible span wire having one end attached to the span wire support and the other end attached to the eyebolt, whereby the tension of the span wire may be varied.



NO. 528,021.

527,927. Electric Motor for Railway Cars. Norman C. Bassett, Lynn, Mass. Application filed June 28, 1893.

There is described in an electric motor having an inclosing shell made of an upper and lower casing hinged and bolted together, trunnions on opposite sides of the lower casing, longitudinal extensions from the lower casing sleeved upon the car axle, and yokes suspended from the main truck adapted to support the trunnions, but readily removable therefrom, so that the motor can be allowed to swing beneath the axle and be suspended therefrom in an accessible position, and held by the longitudinal extensions.

527,947. Method of and Means for Controlling Electric Cars. Harry P. Davis, Pittsburg, Pa. Application filed March 29, 1894.

The inventor claims as novel his method of operating street cars driven by two electric motors, which consists in connecting the motors in series, cutting out one of them, connecting the two in parallel with resistances, and diminishing the resistances in series with the two motors successively, the resistance in series with the motor previously cut out being the first cut out.

527,958. Electrical Signaling System. Bradley A. Fiske, United States Navy. Application filed May 13, 1892.

The inventor claims the combination of a source of electricity, two similar bodies of conducting material located at distant stations, pivoted supports provided at their extremities with contact points moving upon the conductors and combined with one of the supports, so as to be moved therewith, an electrical indicating or measuring instrument having a pivoted index or pointer, the pivot center of the index coinciding with the pivot center of the support, the elements being connected in a Wheatstone bridge circuit.

527,989. Combined Regulating Incandescent Lamp and Socket. Charles A. Hussey, New York, N. Y. Application filed May 14, 1894.

The objects of the invention are to make the construction of the lamp simple, and as nearly as possible similar to the single filament lamps now commonly in use; to provide a socket of simple construction to receive the lamp; to provide both lamp and socket with suitable contact pieces which shall be in contact when the lamp is in place within the socket, and which shall be adapted to convey current to the lamp filaments or to one of them, in any desired manner, without danger of short-circuiting, and to provide a suitable switch which shall be so constructed as to connect the lamp filaments with the wires for supplying current either singly, in series or in multiple, which shall be of a size such that it may be placed within a lamp socket of usual size, which shall be simple and cheap in construction, easily operated, and which shall not be liable to derangement.

528,014. Electric Switch. James F. McLaughlin, Philadelphia, Pa. Application filed May 6, 1893.

The object of the invention is to provide against the possibility of leaving the switch in a condition in which the circuit is imperfectly established, whereby in case of heavy currents the danger of unduly heating or melting the contacts is entirely avoided. With the view of securing this result the movement of the contacts is not controlled from moment to moment by the operator, but is entirely automatic from beginning to end. These movements are produced by a spring which the operator first places under tension and then releases, so that in each case the movement of the contacts is exceedingly rapid and cannot be stopped either accidentally or intentionally at intermediate points.

528,021. Electric Lighting System. George J. Parfitt and George J. T. J. Parfitt, Keynsham, England. Application filed July 12, 1892.

In connection with each lamp the inventors arrange an automatic switch, consisting essentially of a magnet and an armature. The coils of the magnet are so wound that the ordinary current will pass around them without attracting the armature. If, however, owing to the failure of one of the lamps an extra quantity of current flows through the coils, then the armature is attracted and switches in a resistance equal to that of the lamp which has failed. During the time that this is taking place the extra amount of current which flows through the branch containing the lamp which has not failed passes over the bridge, so that the other lamps are practically unaffected.

528,040. Telephone Circuit and Signal. Theodore Spencer, Cambridge, Mass. Application filed November 18, 1893.

The invention relates to a system of trunk circuits and signals in connection with divided switchboards, and also in connection with two or more widely separated central stations, and in association with a common or centralized battery, by means of which signals are sent from the sub-stations to the central station, and also in association with a common or centralized source of electric current, by means of which the telephonic transmitters at the sub-stations are energized, and by means of which various automatic visual signals are set in the central stations, at which the sub-station lines terminate.

528,053. Magnetic Separating Machine. William H. Williams, Newark, N. J. Application filed June 27, 1891.

The invention consists broadly in the combination of a pair of magneto-electric poles arranged pole to pole at any convenient distance apart, and a non-magnetic conveyor moving within the magnetic field between the poles as an intercepting device for collecting magnetic matter; and, further, in specific constructions of the same, in which the magnetic field revolves with the separating drum, and in various specific constructions and combinations of devices.

528,054. Magnetic Separator. William H. Williams, Newark, N. J. Application filed January 29, 1892.

This invention relates to that class of machines known as magnetic separators, in which magnetic force is applied to effect the separation of magnetic from non-magnetic material mixed therewith, its object being to provide a simple, convenient and cheap machine of this class which shall be more efficient than those heretofore in use.

528,055. Magnetic Separator. William H. Williams, Newark, N. J. Application filed January 29, 1892.

This invention consists in an electro-magnetic separator, having a hollow perforated separating drum with an air blast working from the interior, and in various novel constructions and combinations of parts in a magnetic separator.

528,075. Combined Telephone and Signaling System. Henry A. Chase, Boston, Mass. Application filed June 25, 1894.

This invention relates to a combination telephone and signaling system, and has for its object to provide an efficient and less expensive system, in which the use of extra batteries for telephone and ground taps or connections through condensers may be dispensed with, thereby avoiding disturbances from earth currents and obtaining a superior telephonic service in connection with a signaling system. This result is achieved by the employment of a carbon transmitter, which, in accordance with this invention, is connected in a branch or shunt circuit around the signal transmitting apparatus and by means of a circuit controller in the main line, which, when opened, brings the shunt circuit into effective operation to place the telephonic apparatus in speaking connection with a telephonic apparatus at a distant point or station.

528,101. Trolley Wire Switch Plate. Gustavus A. Huben, Springfield, O. Application filed February 23, 1894.

The principal object of the invention is to obtain a strong and light trolley switch. It is so constructed that the operative parts are subjected to the least possible wear.

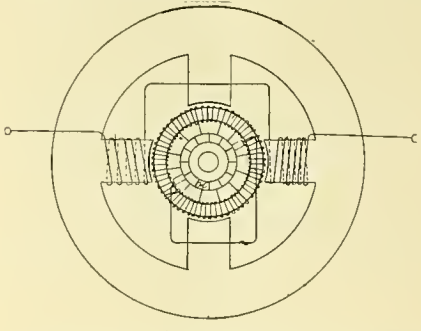
528,119. Electric Arc Lamp. Sigmund Bergmann, New York, N. Y. Application filed April 6, 1894.

The object of the invention is to provide a simple and efficient cut-out for an arc lamp, and it is particularly applicable to protecting the shunt coils of arc lamps which are provided with such coils.

528,121. Alternating Current Motor. Charles T. Child, Ashland, Va. Application filed December 22, 1893.

The invention is a motor in which the secondary coils are in close relation with one or more masses of iron between the poles of the field magnet, as is graphically explained by the accompanying illustration.

528,122. Auxiliary Signaling System for Railways. Mahlon S. Conly, Chicago, Ill. Application filed March 6, 1890.



NO. 528,121.

One of the objects of the invention is to provide safeguards in addition to those now employed in block and other signaling systems which, when from negligence, inability, or any other cause, the engineer fails to observe a danger signal, or the sight target fails to work, so as to notify the engineer of danger, will automatically sound an alarm upon the engine or set the air-brakes on the train, or both, whereby is avoided the possibility of a train passing a point or entering a block where danger exists without notifying the engineer and giving him an opportunity to stop the train, or, where air-brakes are employed, additional security will be furnished by the automatic setting of the air-brakes.

528,127. Circuit Changer for Electric Signaling Systems. John F. Hunter and Samuel H. Lough, Seattle, Wash. Application filed September 3, 1892.

The invention is a circuit-changer box to be used in places where, as in district telegraph or messenger service, it is necessary at frequent intervals to momentarily throw extra battery force on any one of a number of circuits. The object of the invention is to provide means by which one battery may be used to work all the circuits.

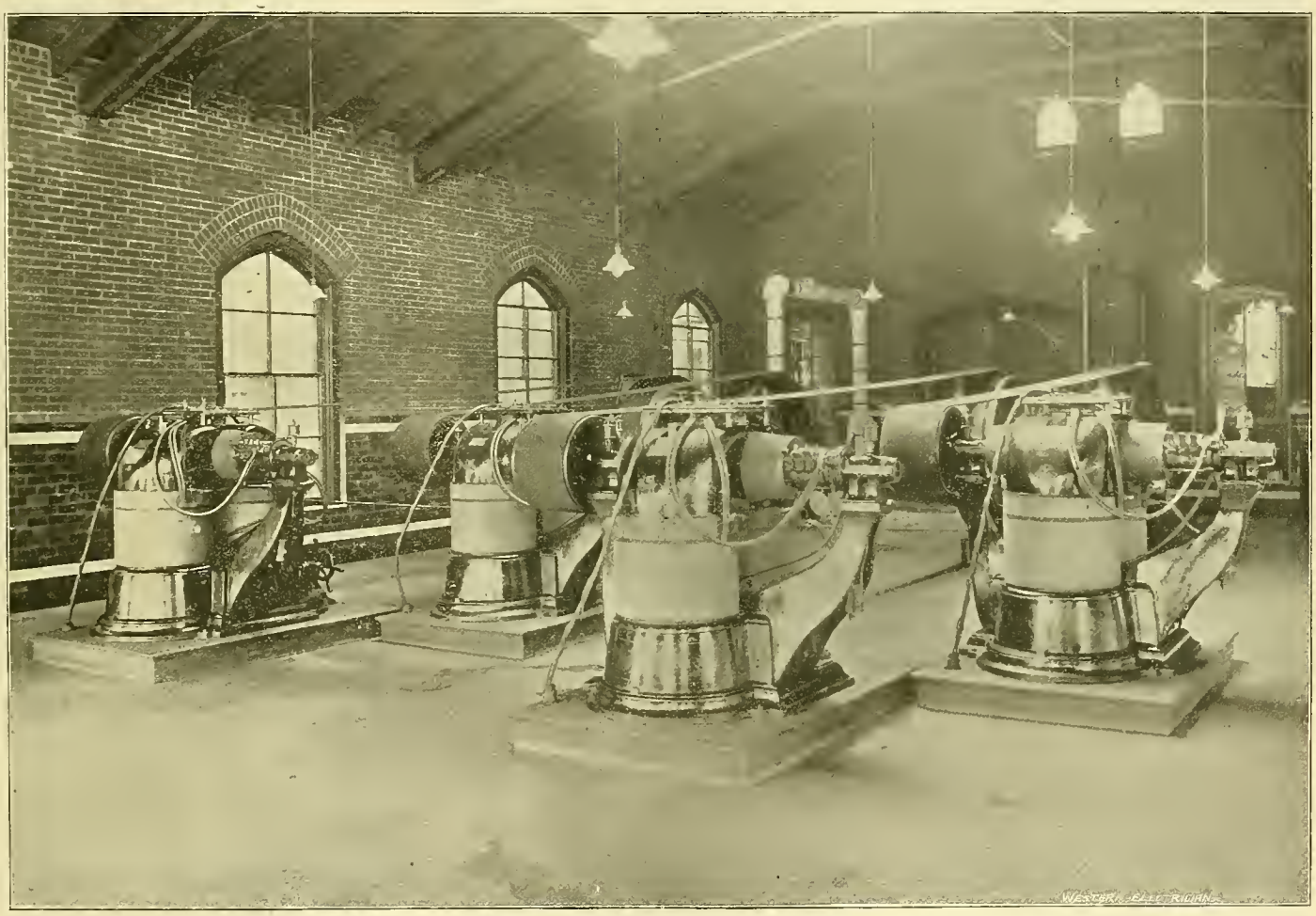
# Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, NOVEMBER 10, 1894. No. 19.


## Lighting Plant at the Cook County Hospital.

Unless it is in mining operations, the advantages of electric lighting over other means of illumination are nowhere more obvious than in public institutions of the character of asylums, prisons and hospitals. The victims of mental, moral and physical disease can be better cared for and guarded more effectually by electric light than by any other form of artificial illumination, while the dangers of fire and vitiated air—both of a very serious character in buildings thronged with incapacitated or criminal men and women—are avoided. This fact is so self-evident that a very large proportion of the public charitable and penal institutions of the United States are now lighted by electricity, and many isolated plants, often of considerable size, are maintained for this purpose.



LIGHTING PLANT AT THE COOK COUNTY HOSPITAL.

A glance at the accompanying illustration shows that the plant of this class selected for illustration—that at the Cook County Hospital of Chicago—is well arranged and exceptionally attractive in appearance. This hospital is located at West Harrison and Wood streets, and is the largest public hospital of the city, having an average of 800 patients. The plant furnishes light for the buildings of the hospital proper, and also for the detention hospital and morgue.

The county commissioners determined to replace the old electric lighting plant by a larger and more modern installation in the summer of 1892, and on September 12th of that year entered into contract with the National Electric Manufacturing company of Eau Claire, Wis., for an entire new plant, the consideration being $5,696.25 and the machinery of the old plant. The plant has now been running about eighteen months and has proved to be very satisfactory.

Current is generated by four National dynamos, but two are amply sufficient to carry the normal load, the plant being established in duplicate generating sets, each set consisting of an engine and two dynamos. These sets are run alternately. Steam is supplied from a battery of ten boilers, each 16 feet by 60 inches, having an aggregate capacity of about 600 horse power. These boilers are fired with block coal and supply steam for all the varied uses of the institution. The two engines are "Ideal," with single cylinders, 14 by 14 inches, and rated at 125 horse power each. They are belted directly to the dynamos, and are operated at about 275 revolutions per minute. The dynamos are handsomely decorated bipolar machines, each having a capacity of 320 amperes at 110 volts. They are compound wound and rated as 600 lighters. The switchboard is of cherry and is fitted with Weston and National instruments. The field rheostats are encased in vertical cylinders standing in front of the board.

About 2,000 lamps are connected with the switchboard mains. The heaviest load is from 8 to 10 P. M., when it ranges from 600 to 800 amperes. As there is no other means of lighting the hospital the plant is run all night. With the exception, perhaps, of the solid wooden switchboard, the plant is a model one, reflecting credit on the county. It is under the supervision of County Electrician R. J. Campsie, and W. E. Dwyer is the electrician in charge.

## Electric Power on the Erie Canal.

The proposed "canal amendment" to the constitution of the state of New York is favored by those who advocate the use of electrical power for the propulsion of the boats. Chief among these advocates is Frank W. Hawley. In a recent interview in the *Syracuse Post* he was asked. "Will not the probable adoption of electricity as a motive power on the railroads render canal improvements necessary in order to compete with them?" To this Mr. Hawley replied: "Most decidedly. It is but a question of ten years at most when freight and passenger trains will be propelled electrically. The cheapness of this method will enable the railroads to transport merchandise at greatly reduced rates. To wield any influence whatever on the great problem of transportation, the canals must not only be improved, but also make use of electric propulsion."

## Telegraph and Telephone Service in New Zealand.

On January 1, 1894, as shown by the annual report of the Postoffice and Telegraph Department of New Zealand, in charge of J. G. Ward, there were 5,513 miles of telegraph line in that colony. There are 640 stations, and during 1893 2,069,691 messages were transmitted. The total revenue was £112,465 15s. 9d., while the expenditure footed up £121,251 3s. The value of the government business, however—the amount that the colony would have had to pay in tolls, at the existing rate, if private ownership prevailed—was £28,317 7s. 10d. For the year ended March 31, 1894, the report shows that 4,244 telephones were installed, at an average cost of no less than £24 12s. 1d. The total revenue was £21,771 4s. 4d., and the working expense £22,217 10s. 2d., showing a loss in this service also. The average revenue from each instrument was only about $24. The total cost of all the telegraph lines, cables and telephone exchanges of New Zealand up to December 31, 1893, has been £719,530 18s. 5d.

A project is on foot to build an electric railroad from Sandusky, O., through Norwalk, Ashland and other places to Londonville, to connect with the Mahoning railroad, thus making a new outlet from the coal mines to the lake.

## Electrical Power in a Chicago Book-binding Establishment.

The introduction of electrical power apparatus into manufacturing establishments has become so extensive that its novelty has partially worn off and its operation has become recognized as reliable and efficient. The simplicity of many of its features and the ease with which it is controlled are making the electrical system a popular one, and many of the later installations have been so admirably designed and efficiently laid out that they may be taken as models for future construction. Some of the smaller electric power plants, favored with proper conditions, rival in interest many of the larger and more pretentious installations, and show the wisdom of the choice on account of their unobtrusiveness in the factory room and their ability to make possible sub-division of shafting suitable to the needs of the establishment without the loss of power attendant upon other systems.

It would be a difficult matter to find a neater electric power plant or one which is doing more satisfactory service than that installed in the book-binding establishment of Shea, Smith & Co., Chicago. The work demanded of the motors is at times considerable and of a trying character, and changes of load of wide proportions are constant. Yet practically no attention is given them, and, protected from exterior accidents by wire screens, they regulate themselves

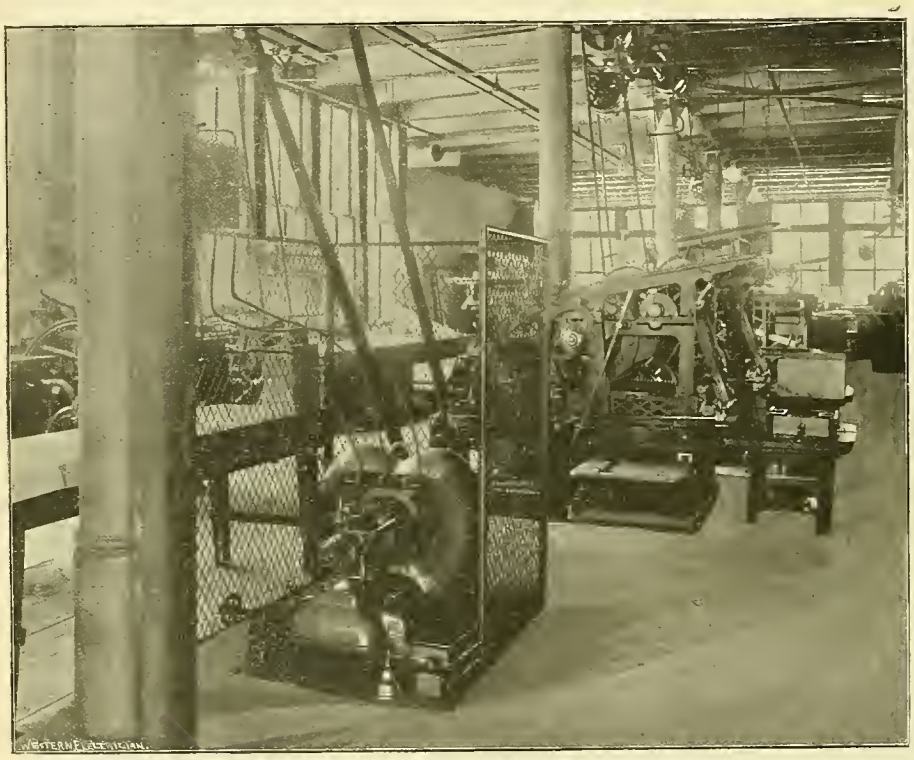


FIG. 1. ELECTRIC POWER IN A CHICAGO BOOK-BINDING ESTABLISHMENT.

to their work and occupy an exceedingly small amount of floor space. In the illustration, Fig. 1, is shown a five horse power motor of the C & C standard type actuating shafting by belt and pulleys, for running paper-cutting machines and presses, as well as other machinery incident to a business of this description. Power for this whole floor is taken from this motor, while two other floors in in the building are supplied with power from 7½ and 3 horse power motors respectively. An almost entire absence of noise in the factory is one of the pleasing features of this installation, and the fact that one department most remote from the generating machinery may be in operation while the remainder of the building is shut down is an advantage which cannot be too strongly emphasized.

The generating apparatus, shown in Fig. 2, consists of a 30 kilowatt, compound wound C & C generator designed to be operated at 850 revolutions a minute by a 75 horse power Ideal engine with 11 by 12 inch cylinders. A Stirling boiler of 100 horse power capacity furnishes steam for elevators and for heating the building as well as for the engine, which is of sufficient capacity to allow the addition of another generator if it should be necessary. The building is wired for three circuits, as current for light is also supplied from the dynamo. At present current is demanded for six arc and about 200 incandescent lamps. Although possessed of no absolutely new features, this installation is worthy of attention as an example of clean, simple, economical practice in electrical power transmission for factories. It was installed by the Chicago office of the C & C Electric company.

## Transfers on Street Railways.[1]

By. J. N. Beckley.

The carrying of a passenger from any part of a city, reached by the lines of a street railway, to any other part of such city, reached by the lines of the same railway, for a single fare is, speaking broadly, a new thing in street railway operation. Ten years, even five years, ago the manager who had the temerity to advise his board of directors to establish a liberal transfer system would have, probably, been regarded as unfit for his position. To-day the most successful companies have come to realize that in this matter of transfers, as well as in other matters, it pays to treat the riding public liberally.

One of the most important things to do, and to do promptly, is to educate the average man and woman to ride. That this is largely a matter of education every street railway manager knows. When a new line is opened, even through a thickly settled district, the people for some time continue to walk. Bad weather, the necessity of haste or some other thing induces a person to ride once. The next time he rides with less inducement, especially if the cars are clean, the service prompt, and if he does not have to pay more than five cents to get to his destination. So the habit grows, and soon the rule is to ride, when, before, it was the exception. A liberal transfer system, properly guarded to prevent fraud, pays. This is, I think, now generally recognized. Local conditions and arrangements of lines must be considered in determining the regulations to be adopted. The rules intended to safeguard the company are important. Perhaps equally important is the making of rules broad enough to encourage riding.

If a transfer system is adopted, it is best not to hedge it in too much by narrow restrictions or to so complicate its details as to involve labor and expend money unnecessarily. It is expedient also to appear to be making most liberal concessions to the public, especially as such concessions—presumptive or real—conduce to our own benefit. The punching "to and from"—the limit of privilege to use at absolute junctions as fixed spots—different forms and even different colors for different issuing lines, may in most cases be avoided. If we secure a proper form of ticket, we can be protected in less complicated ways, and it is usually possible with careful arrangement to cover all requirements in one form. If series and consecutive numbers be employed, we can easily trace all issues by them instead of by old methods. If we use the series and consecutive numbers, we allot a certain quantity of tickets to each conductor and follow him by them and should avoid minor details that interfere with or complicate the more important ones.

The ticket should be of liberal size to permit legible type and prevent crowded matter.

It should be bound in pads of 100 and the pad be so exactly arranged as to permit punching ten or more in one action of the punch. This feature permits canceling the month and day, and often the time, ten or more at once and accurately, and frequently several of the same destination. It is of great advantage to secure full "month," "days" and "time" space on each ticket—that can be accurately and quickly punched, and it forestalls the waste, expense and detail consequent upon daily dated tickets, while it gives equal protection without delay anywhere.

The subject matter ingeniously arranged can and should comprehend in one form all needed rules. "Good for this current trip—at point of change—on next car after time canceled—to destination punched," illustrates this. "Subject to rules of company" covers several dozen words of the old form with equal rigidity. Special conditions may vary this, but in most cases it is restriction enough.

"A series number"—"conductor's number"—"run" of "car" number or some such designation on each ticket will identify the issuer perfectly, and the consecutive number will trace the issue, hold it to sequence in use, and prevent tampering and fraud. We have some 200 conductors. Each has a stock of 25,000 tickets to begin with, renewed as used. Our transfer department has 250 compartments on the wall of the room to hold these tickets (thus providing for increase in conductors), each of 25,000 capacity, so they are all systematically arranged in simple order, one compartment for the tickets of each conductor. The conductor turns in his unused transfers at the end of the day's work, and they are put in his compartment, and given out again to him on beginning work next day. A simple record book keeps this account; one double page for each conductor covers his transactions for the whole year, and shows at a glance each individual transfer account, for comparison or aggregating statistics.

Forenoon and afternoon are distinguished by light and black print in the destination blocks, and by the system we use we get month and day *one* punching each (but always preliminary, the conductor keeping these punched ahead in readiness), and *one* punch for time (even hour or ten minute interval) and *one* for destination. I need not explain that such a ticket supplants the expensive duplex form—for it is equally protective—nor enter upon any argument in favor of the absolute need of a short time limit. The day limit, A. M. or P. M. limit, or even the hour limit, is of a by-gone day, too leaky to be considered, and very few companies now use it.

It is important, in my judgment, to arrange the form clearly, each section, name, rules, time, days, months, destination, series and consecutive number to have a distinct and spacious position and be clearly defined by itself, not scattered about. It is also very important, in order to foster accuracy with rapidity, to so arrange the reading matter that the ticket shall be punched and read as punched, all one way, being held by thumb and finger of the left hand and punched with the right. Inverting and twisting the ticket not only takes time, delaying traffic, but increases inaccuracy. The ticket should be arranged in every detail so as to be within the mental grasp of the average conductor, and so as to make it easier for him to go right than to go wrong, easier to be quick than compelled to be slow. Regular horizontal and vertical lines soon fix themselves on the dullest intellect, but scattered details, hopping about a ticket, often puzzle the brighter ones.

In order that all punching may be done before tearing off the ticket from the stub and that all possible advantage of the pad form and multiple punching can be secured, all sections to be punched should be arranged on the lower side and right hand end if possible.

The pad form saves counting the 100s, while the consecutive number counts the broken pads. The pad form is most convenient in handling in the office or on the cars and saves time wherever used in giving out, in issuing or receiving or in taking stock. The use of the months is not important. If there be room for them there is no objection, as with the pad form they are no obstacle to quick service, as they can be punched in advance of use. Many companies omit them, as the other restrictions practically give little opportunity for fraudulent use after thirty days. By beginning the consecutive number of each pad at 0, 100, 200, etc., we save complication in subtracting, as then the consecutive number on the upper remaining ticket instantly shows how many tickets have been removed.

The consecutive number is not only useful in counting, but compels proper use of the tickets. In conjunction with the time-table each ticket must show when turned in that it was issued in sequence of number and in sequence of time. No. 6,230, say, is issued at 9:30 A. M. Nos. 6,231 and 6,232 may not be returned at all, but if they are they must show issue in direct sequence of time. If not so, the series number tells us instantly who issued the ticket, and the man is spotted and the wrong exposed, for tickets cannot be abstracted and punched for future use, as they will not fall within proper time limit and in proper sequence. We make conductors note on the daily car report the consecutive number of the transfer with which the day's work begins and the consecutive number with which it ends. At the close of each trip each conductor turns in the transfers taken in on such trip in a special trip envelope, dropping them in a box prepared for that peculiar purpose. This box is placed at our grand junction, which all cars pass, but a number of such boxes could be used where different conditions obtain. We know at once who wrongly issued a transfer, and who received it and when it was done. A notice in our cars requires the passenger to ask for a transfer when fare is paid. This rule enables the conductor to issue transfers at his convenience, and distributes the labor of so doing instead of massing it at certain junctions, with confusion and delay.

Nor is it necessary to resort to tickets on a roll or in metal clasps or such devices for protection. The roll method necessitates single issues, singly punched, and loses the advantage of multiple punching, while it delays traffic and increases chances of error. The metal bound tickets add expense, but do not increase protection. Tickets may be just as easily abstracted in advance of proper use as in the pad form—so they may in the roll, for that matter. Real protection lies only in the system, not in the binding. Conductors cannot sell, trade or exchange transfers with series consecutive numbers and time-table without detection, and if the transfers be turned in on every trip detection is a very simple process, requiring no elaborate and costly inspection.

A special register for transfers, and so eliminating their cash value, doesn't help us. It confuses the conductor and paralyzes the spotter, and without a protected form of ticket conductors can collect fares and ring them up on the register, and turn in each other's transfers to balance the account.

By putting the transfer business into the hands of the conductors, we cater to the convenience of passengers, and we obviate delays in traffic, consequent upon stopping cars to transfer. We save the large expense of transfer agents, and, in my judgment, do not increase leakage, for it is as easy for transfer agents to "stand in" with conductors to defraud the company, as it is for conductors to combine with

1. Read before the American Street Railway association, October 19, 1894.

each other. The numerous and continual frauds perpetrated upon transfer agents, by people who get transfers without having paid any fare, is too well understood to require discussion.

We have adopted a system of "faces identification" for moral effect, and especially for use at the noon hour, when abuse in transfers is most frequent. As soon as we have converted our stock of tickets to the new form, we shall put them into effect. They are, I understand, now in use in Minneapolis, St. Paul, New Haven, Binghamton and Scranton.

In conclusion, I need only add that our liberal system of transfer has proved a good investment, and that our form of ticket is efficient and protective. Simple, convenient and safe, yet systematic, distinct and business-like, it protects our interests, while it saves us all former waste and a vast amount of useless labor.

## City and Suburban Electric Railways [1]

By E. C. Foster.

It is difficult to make the distinction between city roads and suburban roads. The function of nearly all city roads is largely to convey the people from the residential districts, mainly in the suburbs, to the business sections, and likewise from the latter to the former. In the improvements it has made in this class of transportation lie the greatest benefits of the application of electricity to street car propulsion. The growth of our great cities has resulted in the appreciation of value of all real estate near the business sections, to a point where the only residence a working man can afford in these districts is a tenement house. These tenements are invariably crowded to a degree that is unhealthful. That the electric railway has done much for humanity in enabling the working population to leave these homes in the congested districts, and procure more comfortable and respectable ones in the suburbs, goes without saying.

Next to this most important use of the electric railways comes their use in furnishing recreation for the masses of the people. Nothing accomplishes so much in the elevation of our population as frequent opportunity to cultivate acquaintance with nature. Optimism is the natural and healthy condition of the mind, and nothing encourages one to look on the bright side of life as does a ride or ramble through the country. The combination of fresh air and pretty scenery makes the only tonic that tones. The two necessary considerations in the accomplishment of the scheme of country air for the masses are, first, the public parks, and, second, the means of transportation to them. It is only within the past year that, in the state of Massachusetts, a State Public Park Commission has been created for the purpose of purchasing large tracts of land and opening them to the public, that they may enjoy the beauties of nature without trespassing upon private property. On a portion of the Blue Hills, only ten miles distant from the heart of the city of Boston, over 1,200 acres have been secured to be preserved forever for the benefit of the people. Also, in Arlington, a like distance in another direction, a large reservation is made; Middlesex Fells in another, and the commission is now turning its attention to the shores of Revere Beach, immediately north of the city, one of the grandest beaches of this continent. It it needless to add that the street railway companies are doing their share in the matter of providing the necessary transportation. While their motives are not purely philanthropic, the results accomplished are of almost as substantial benefit as though the people only were considered. While this fact is very greatly appreciated, there seems to exist a growing feeling, on the part of some, that the street railway companies get everything and give nothing. Certainly the very evident benefits the people have secured, coupled with the fact that few companies have earned more than moderate dividends, and many none, should be enough to convince the most skeptical that the stockholders' experience is not always a profitable one.

However, I presume that it was not expected of me to devote this paper to a demonstration of the advantages accruing from the existence of electric railways, but rather to consider the question of the operation of roads and the projection and construction of new lines. It seems almost useless for me to tell you, who know, certainly as well as, if not better than I, how to operate existing reads, and how to determine what lines will pay, and under what conditions of fares and traffic. When I say, hereinafter, that such a thing should be so, even though it be without modification, you must understand that I offer such only as my opinion, formed from my own experience, and not necessarily as an established fact.

As a road is projected, and studied from a financial point of view first, then constructed, then operated, it may be well to consider these topics in this same order. The first point, covering the work preliminary to the construction, admits of nothing but rather general discussion. As it is not the purpose of this paper to consider roads built to yield their dividends in benefits to allied interests, as in developing real estate, it may be taken for granted that the question of primal importance, in the consideration of a proposed line, is its probable earning capacity. The stimulation to the growth of the country crossed may be considered only in the reflex effect that such growth may have upon the business of the road. A line to pay should be one that makes itself a necessity to the people, in offering them the best facilities for transportation in the particular direction. Competing lines should be avoided, excepting where the volume of business is large enough to support both. Beside the assurance that the line is necessary to the people accommodated, it must be ascertained that the number of the latter is large enough to support the road on a paying basis, not only the first year, when the repairs are slight, but later, when reconstruction becomes necessary. I consider that there are very few cases where a company is warranted in investing its money in a line, on the strength alone of the future that may be expected from it. A road should be at least capable of earning its operating expenses from the start, and the evidence of a more prosperous time, later on, should be very strong, before it is constructed without immediate promise of good dividends. It is sometimes necessary for an established company to build on a location, merely to keep out competition. The only thing that warrants this is the knowledge that the opportunity exists for the proposed competing company to be self-supporting from the start, and ultimately a serious rival. Otherwise it is economy to allow them to build the road and buy them out at the foreclosure sale.

Track construction is a subject that has been so thoroughly discussed in all its details that I shall not attempt to do more than express my opinion, in a general way, as to what forms are best suited for the various demands of the suburban roads. The kind of construction most desirable for a certain location depends, of course, entirely upon the particular conditions. For roads connecting towns, I think that it is often possible to secure an independent right of way for a very slight cost per mile, and very often for nothing; this might require special legislation. Progressive landowners realize that the one way to enhance the value of their real estate is to put it within means of easy communication with the surrounding neighborhood, and especially the principal town. For this reason they are often willing to give the necessary land for an electric railway—without any undesirable conditions or restrictions—and oftentimes to contribute something toward the grading. If, in this way, the right of way can be obtained that is desirable as to route and grade, it offers many advantages that cannot be had on public highways. For such a right of way the regular steam road form of construction would be employed. About a 60 pound T rail, 6 by 7 inch oak or chestnut ties laid with two feet centers, needle switches with lever throw, etc., would give a track that would allow a speed of forty miles an hour, making it necessary to slacken speed only for curves, and as much for switches as the overhead construction demanded, the track switches requiring no reduction of speed. Curves, in such a road, should be few, and of the longest possible radii.

Where it is decided to build on country roads, a location at the side of the road is, of course, preferable. Here T rail may be laid, and the track filled with gravel, covering the ties and leaving the heads of the rails entirely exposed.

In the streets of smaller towns, where permission can be obtained, it is also desirable to lay T rail, although there is always more or less trouble maintaining the paved brow that is usually required, and consequent difficulty in plowing snow from the track, due to the shears and diggers of the plow striking the partially displaced blocks.

In city streets and others that are paved the girder rail seems to be the only one suitable. In order to obtain the necessary depth for paving, this rail should be nine inches deep, and should weigh about 90 pounds per yard. This makes very expensive construction, but the expense is justifiable when the conditions are considered. While such construction is necessary, where laid in streets paved from curb to curb, it is an open question in my mind as to what is best in macadam streets. There are many lines that are operated on 15 or 30 minutes, or even on hourly intervals, where the business is hardly such as to warrant the use of track construction costing from $20,000 to $30,000 per mile. The frequency of the service is an important factor in determining the most economical construction for use under particular conditions, and I think that the nine inch girder rail ceases to become a necessity, and becomes a luxury, when the number of cars run over it daily is reduced below a certain figure. Further, there are positive objections to the use of such rigid construction as this in dirty streets, as in macadam streets where the top-dressing contains a great deal beside stone. My experience has been that the rail becomes covered with dirt, and that the cars rattle and "chatter" badly in running over it, more than in running over a dirty rail of less rigidity. It may seem revolutionary to suggest it, but I think that, for certain places, it is at least worth while to consider relaying good tram rail, using some approved form of joint plate. I am not quite convinced in my own mind that there are conditions existing where this is warrantable, but the subject is certainly worthy of discussion and consideration.

Overhead line construction has kept pace in its improvements with those of the other branches of electric railway work, and the success that has been had with the lines built during the early periods of development encourages one in the belief that modern lines may be depended upon to give little trouble.

Regarding equipment, my idea is that the longest car that can be operated successfully on four wheels is the most desirable for the ordinary conditions. For long distance lines having heavy traffic, I would recommend thirty foot bodies, on double trucks, for box cars, and fifteen bench open bodies, on similar trucks. Where there is a sufficient demand, I should run a combination smoking and baggage car as the trail car of a train of two.

In building a new road for short distance travel, I should give all curves the necessary radii for the use of seven-foot wheel bases through them, and have trucks this standard. On these trucks I should use twenty-foot box cars and ten bench open cars, either class measuring about twenty-nine feet six inches over the buffers. As a supplement to the regular equipment of motor cars, I recommend trailers, and that they may be run economically a power brake is necessary. To meet this demand, the air brake is being developed, and promises to fill the requirements. For convenience in attaching trailers to motor cars, automatic couplers are necessary. There are several forms of latch couplings that can be made to do the work satisfactorily. An important thing in connection with the use of trailers is the adoption of, and adherence to, a standard, that all buffers and drawbars may be of one height, and other parts right for the proper operation of cars in trains.

For electrical equipment, it goes without saying that the modern multipolar, single reduction motors, with series-parallel controllers, are the only ones that a road can afford to use. The performance of the various equipments, now manufactured by the different companies, has been so universally satisfactory that I feel that a great deal has been accomplished in the past two years in the development of the car equipment.

I am a firm believer in the desirability of heating all cars in the North, thinking that it has a very important effect upon receipts. As much as I like the results obtained from electric heating, I hardly feel that we can depend upon this method. Our experience is that it takes from eight to twelve amperes to keep a twenty-foot car comfortable, that is, forty degrees above the outside temperature. This means that it requires about as much current per hour as to propel a car four miles. This would make seventy-two car miles of power per day of eighteen hours, chargeable against the heaters. When it is considered that this extra power is often demanded when power is needed for other purposes, as in snow storms, it may be seen that, aside from the question of cost of coal, the consideration of the necessary increased capacity of the power station and feeder system is an important one. Having put myself on record as opposed to electrically heated cars, it is probably expected of me that I present a method that is satisfactory. Unfortunately, though, this I am unable to do. For short trips, run from a car house, the hot water storage system may do. We still depend upon the stove, and "with all its faults we love it still," until we can find something that we consider an improvement upon it.

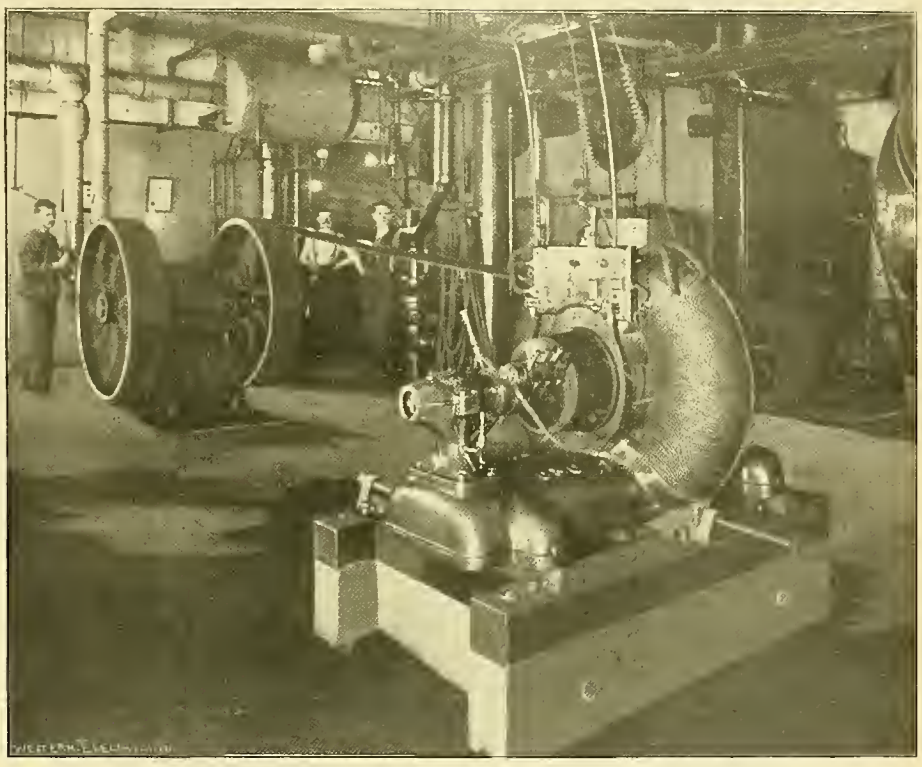


FIG. 2. ELECTRIC POWER IN A CHICAGO BOOK-BINDING ESTABLISHMENT.

1. Read before the American Street Railway association, Atlanta, Ga., October 18, 1894.

It is not improbable that before long a telephone will be considered a necessary part of the equipment of each car operated on suburban lines. It often happens that means of communication with the nearest car house, or with the starter, would save much delay, and even danger, in cases of cars disabled or thrown off their schedule time by other causes. Either a telephone in each car, with means of plugging in on convenient poles or 'phones arranged at the turn-outs in boxes may be used. As a substitute for this arrangement, or in connection with it, a system of signals between turn-outs may be desirable under certain conditions. By the use of lantern boxes, containing incandescent lamps, and the necessary hand or automatic switches, a simple system of signals may be devised, by means of which cars running between turn-outs on single track lines will be protected from meeting other cars.

While these devices may be necessary in some cases, they will always be more or less burdens, in the complications they add. The signal system, especially, has one important objection. Regardless of the most carefully enforced rules to the contrary, men will learn to consider it as freeing them from the necessity of maintaining the same careful outlook for approaching cars, and in cases of failure of the signals accidents will be more likely to occur than they would without the signal system.

The adoption of a proper schedule of fares and transfers is a most important matter. Where lines are short enough to allow the use of the one standard fare throughout, this question is a simple one, but where routes are longer, and it becomes necessary to collect higher fares, complication commences. When this latter condition is aggravated by systems of transfers the complexity increases. My experience has been that, in general, it is best to divide such a line into sections, collecting a single fare in each, and registering all as the standard fares. These sections are arbitrary, of course, but in our case are determined by town boundary lines. For instance, where we have a line running through several towns, we collect a single five cent fare in each town. In connection with this, I would say that there are instances where further restrictions need to be made. Cases have arisen where towns of large area have comparatively small centers of population a long distance apart. Single fares have been established as being good anywhere within the limits of either town. A line is then built connecting the two towns, and instead of ten cents, it is considered necessary to get fifteen-cent fares. The question then arises as to how the required three sections can be arranged. According to established precedent, the five-cent fare sections include each whole town, although the line in question did not exist when this understanding was originated. In this case, however, it becomes necessary to establish the third section as including that part of the line between the boundaries of the more thickly populated portions of the towns, and including the intervening open country in both towns. As an exception to this method of paying fares "on the installment plan," I would mention the case where there exists a very heavy through traffic on a line, compared with which the local traffic is slight. In this case I consider it best to collect the whole fare at once, issuing to the through passenger conductors' private checks. These latter are held by the passenger, as evidence that he has paid through fare, and surrendered to the conductor before the end of the trip.

The selection of the best rates of fares is a matter requiring the consideration of numerous conditions governing the particular case in question. It is safe to assume that the result to be worked for is the earning of the largest possible net revenue, considering, at the same time, the development of the business. Exactly the best way to accomplish this is the problem to solve. The expense of operating may be approximated reasonably close. It is more difficult, however, to determine the amount of traffic that different rates of fare may bring. It is well to study the classes of travel that may be expected, and fix such a basis of rates as will probably yield the largest margin of profit. After having done this, the basis thus determined may be increased by a considerable percentage, and this new basis adopted as one to use in opening the road. As everyone knows, it is a simple matter to decrease fares, and while I do not believe in starting out with high rates merely for the opportunity of obtaining the credit of cutting them at some future time, I do consider that it is necessary to have a margin of safety, to avoid the possibility of being burdened with rates that are too low, and cannot possibly be raised. In this state, with the existence of a law making it illegal for railroad companies to withdraw transfer checks issued without permission from the railroad commissioners, it becomes more than ever necessary to very carefully consider all proposed changes, studying them especially as to their probable effect in the future, when the road has developed and taken in new territory. It is aggravating to see the opportunity for a new line, into a district that might naturally be expected to pay by means of a rate of fare higher than the standard, and have the fact of a previously established rate, that can be construed to cover the line in question, standing in the way of the consummation of the scheme. I consider 1¼ cents per mile a minimum rate for the basis of a system of fares, no fare to be less than five cents, and would advise the establishing of higher rates, up to two cents, as the particular conditions would seem to recommend.

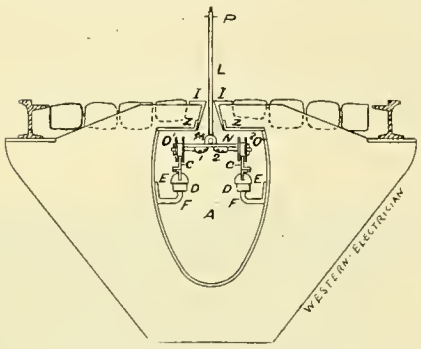



FIG. 1. HEWETT'S CONDUIT RAILWAY TROLLEY.

In certain cases I think it advisable to sell round trip tickets. Our fare from Lynn to Boston is 15 cents, but we sell two tickets for 25 cents. We think that the possession of this return ticket leads people to use our cars when they would otherwise patronize the steam roads. We have no other commutation, excepting workingmen's tickets over certain routes, good only during the hours of six and seven, morning and evening,

Transfers may be used within reasonable distances. The system must, of course, be carefully worked out, to avoid the possibility of abuse. In all of our efforts to be just to the public we cannot lose sight of the fact that the public is not just to us when it can avoid being, and that it behooves us to take the necessary precautions to protect ourselves, inasmuch as the popular moral code includes no provision for our protection. The existence of this unfortunate condition of affair demands that we use care to prevent the abuse of the privilege we grant the public, the most common form of which abuse is the failure to observe the "not transferable" restriction.

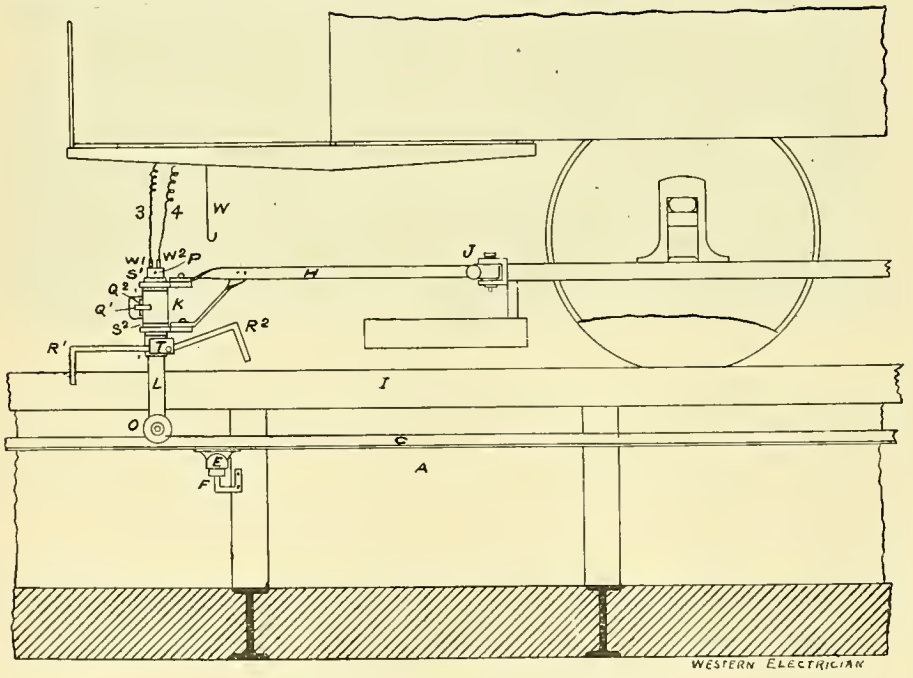



FIG. 2. HEWETT'S CONDUIT RAILWAY TROLLEY.

Suburban roads work at a disadvantage compared with city roads, when the question of operating expense is considered. There are many reasons why a given number of cars can be operated for less money within a small territory than when spread over a large area. These reasons are obvious. In the former case a large number of cars may be cared for in one car house, thus allowing a minimum expense of maintenance. A small car house cannot afford the motor tables, traveling cranes, etc., that do so much to lessen the cost of motor and truck repair, nor can the work of the small house be divided among different men, giving each his specialty, as in a large house. In one of the largest car houses in the world, the Lenox street house of the West End Street Railway company of Boston, two men fill all grease cups, examine and replace brushes, and inspect other parts of the motors of from one hundred and twenty to one hundred and fifty cars, daily. The other work in this house is divided up among some twenty men, including carpenters and blacksmiths, so that the average is abqut six cars per man. This number of cars per man is often assigned, but probably the work is seldom so well done as in this house. Another important disadvantage under wich the suburban road labors is that of the high cost of power. It usually is dependent upon a number of small stations, due to the fact that it is impossible to cover the necessary territory from one station, and both the labor and coal consumption of small stations are necessarily greater per car mile than are those of large ones. The opportunities of making the expense in the first instance, that of car house work, compare favorably in the small house with the large are rather few. They lie in the dependence upon one capable man, circulating among the houses, directing the efforts of lower priced labor. Another idea that suggests itself is the equipping of one house with a complete outfit of labor-saving applhances and bringing all unusual repairs to this house. This is objectionable, however, in that it requires the moving of cars over long distances, at a time when they are least in condition; and, further, that it makes two gangs of men responsible for the care of the cars. Regarding the elimination of the difference in power costs, now existing in favor of the city road, the indications are that the time is coming when it will be no longer necessary for the country road to maintain its numerous steam plants. I refer to the probable introduction of the alternating system of long-distance electrical transmission into railway work. Suppose the case where it becomes necessary to distribute power for railway purposes over large areas, as on many suburban roads where several power stations are now used. With this system, there need be but one main power station, which can be located at the point possessing the greatest advantages for cheap production of power. At various selected places rotary transformers may be placed, one for each section of road. These receive alternating current, over long-distance lines, from the main station, and deliver it as direct current to the trolley wires, or possibly to such local feeders as may be necessary for the distribution throughout the particular section. These rotary transformers require only the same care as generators. Beside them, the only apparatus in the sub-station needing attention would be the circuit breakers. The latter would be arranged between the rotary transformers and the lines, in the same way that those in the present stations are. It will be seen, therefore, that one ordinary dynamo tender would be all the labor required in a sub-station. Further than this, the sub-station might often be in car houses, where one of the regular employes could care for the machinery, thus reducing the labor charge to a minimum. By this arrangement power could be distributed to cars operating over areas of from twenty-five to fifty miles radius from one station, at cost slightly above that for distribution within the ordinary distances of present practice. I am told that with such a system, using 6,000 volts, three-phase currents, from a station located at the central point, we could supply power, by the use of three No. 0 B. & S. wires, to a road fifty miles in length, when fifty cars were being operated. The total efficiency of this transmission, neglecting the loss in the trolley wires, would be about 65 per cent. These fifty cars, on the fifty mile road, would give fifteen minute headway, with a speed of eight miles per hour. With the higher speed, that would more probably fit the conditions of such a road, the number of cars would be reduced, allowing a proportionate decrease in the size of the wires, so long as the current allowance, 20 amperes per car, was sufficient. To accomplish these same results with the present system of 500 volts would require 600 No. 0. B. & S. wires, the use of which would, of course, be impracticable.

While this system has many advantages which are sure to result in its extensive application, it has its attendant disadvantages, which must be overcome. Most important of these is the difficulty of insulating the lines. Practice has been to use bare wire, simply because the covering is of no use with such voltages. The principal use of the insulation on the majority of overhead wires is a sentimental one. The public prefers the appearance of the covering to the bare wire. It is probable that it will be wise to recognize the existence of this preference, and cover the wires, merely to save comment. The most serious difficulty, however, lies in the fact that it seems to be absolutely necessary to keep the wires out of the trees. George D. Johnson, superintendent of the Hartford Electric Light company, writes that a twig short-circuits their 5,700 volt mains almost as readily as a wire.

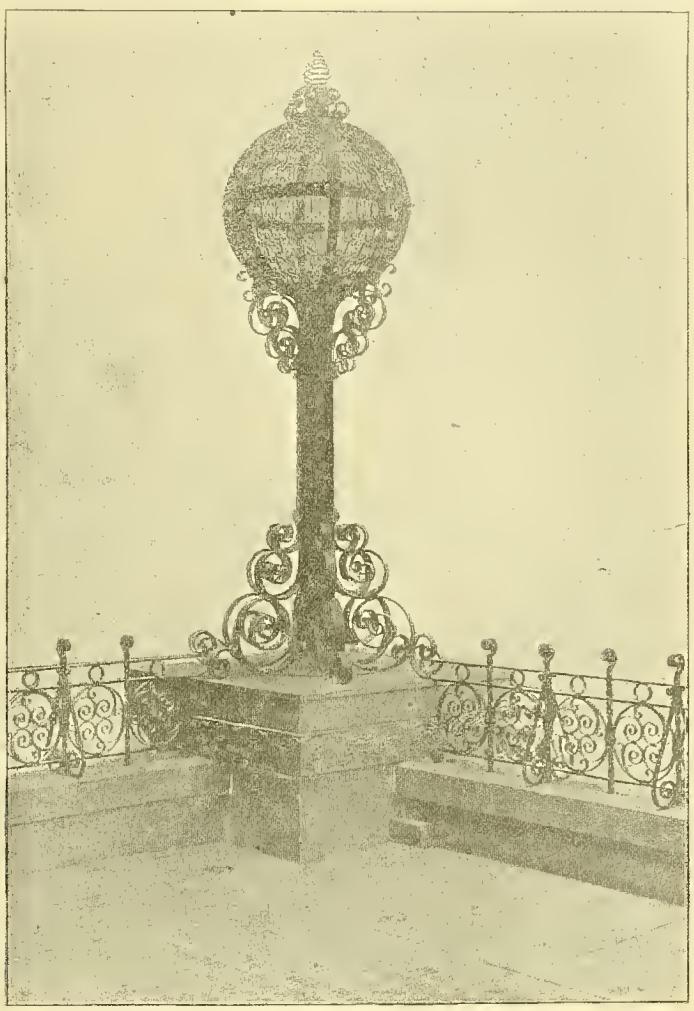
It will be evident that the adoption of a long-distance transmission system will admit of the use of any suitable water power that may be located too far away to be available under the direct method of transmission.

Although I have discussed no branch of my subject sufficiently in detail to treat it thoroughly, I feel that I have already taken more than my share of your time. In conclusion, I would say that I have very great faith in the future of the electric railway. It has demonstrated its ability so live through periods of adversity. The lesson in economy that the country in general has had has taught us a great deal with the rest. Roads that have paid expenses during the past two years will have nice margins of profit left from the receipts of the years to come, and those that have paid their dividends will pay larger ones and add to their sinking funds. While a considerable part of the curtailment, made necessary by reduced receipts, has been in the line of the sacrifice of repairs that should be made in prosperous times, there have been many unnecessary expenses brought to light and cut off. Things which we thought necessities proved to have been luxuries when we learned how well we could do without them. I am a firm believer in the policy of putting everything into the best of condition and keeping it so, as being the one that yields the largest net revenue, present and future, but I realize now better than I did two years

ago, that in our zeal to have the best of everything, kept in the best of condition, we allow extravagances to creep in, with the necessary expenditures. The education in economy that we have gained will help us wonderfully in the future, and the combination of increased earnings and reduced expenditures will give an increase in the net revenue that will be substantial.

## Ornamental Electric Light Standards.

That there has been marked advancement in the manufacture and design of electrical fixtures is evident to all who have watched the development of this line during the last few years. More attention is given nowadays to graceful proportions and artistic ornamentation than heretofore. A striking illustration of this is afforded by the handsome standards designed by T. C. Link and manufactured by the Ludlow-Saylor Wire company, St. Louis, for the new Union station of that city, the electrical features of which were described in the WESTERN ELECTRICIAN of September 22d. These standards are made entirely of iron, with black iron finish, and rise to a height of nine feet. They are placed on either side of the *port cochere*, which extends beyond the main entrance to the station, and the *port cochere* is also surrounded by an iron area rail, a portion of which is shown, together with the view of the standard in the accompanying illustration, which is reproduced from the *Iron Age*. There is about 75 feet of the area rail, which is finished the same as the standards.



ORNAMENTAL ELECTRIC LIGHT STANDARDS.

## Hewett's Conduit Railway Trolley.

The conduit trolley herewith illustrated was designed with a view to provide a system appplicable to the practical requirements of street car service, where the trolley should be designed so as to run in either direction with little readjustment; pass curves, frogs and crossings without displacement; be easily detached from the car, so as to provide for through car service with overhead trolley lines, and be easily removed from the conduit so as to provide for the transfer of rolling stock from one track to another in case of fires or other street interruptions where the car service has to be interrupted and turned back.

In conduit systems using under-running contact devices the conductors must necessarily have gaps at crossings and switches of sufficient width to permit the passage of the carrying bar. This necessitates complicated crossings and switches. For this reason an over-running trolley device has been planned, as in such a plan the contacts and carrying device all travel above the conducting bars. Crossings and switches can therefore be of the most simple design.

The trolley device has been designed so as to be easily accessible, to run in either direction, to automatically adjust itself to the proper angular position for passing curves without displacement, to be easily detached and to permit cars to pass freely over it while detached, and to be easily removed from the conduit.

The accompanying drawings illustrate the main features. In Fig. 1 is shown a cross-section representing the permanent way conduit and interior thereof. Fig. 2 is a sectional side elevation, showing one end of a motor car, the trolley device, conducting bars, insulators and interior of the conduit.

In Fig. 1 *A* is a conduit 29 inches deep and 18 inches wide and constructed of concrete, similar to cable railway construction. The upper part, however, is formed with flat roof composed of roof plates *Z Z*, of cast or wrought iron, resting on the overhanging ends of the yokes. On this roof plate is placed a sand bed and paving material, such as stone or wood blocks, cobblestone or concrete and asphaltum, as the nature of the street traffic may require. The slot rails *I I* are of the same pattern as those used in cable railway construction, and extend slightly below the roof plates *Z Z*, so as to form dripping edges. The conduit roof is made flat instead of arched, so as to provide shelter for the conducting bars and insulators, thus placing them as far out of reach of the slot as possible. The insulator *D* is of any suitable pattern, such as used for heavy line work, and is fixed to the conduit yoke by means of a cast-iron bracket pin *F*, as shown. Oil insulators can be used when necessary. The conducting bars *C C* are of angle iron and are fixed, as shown, on the top of strong bell-shaped insulators *D D* by means of a fixture. The fixture consists of a metallic cap fastened to the top of the insulator by means of two pins, which pass through the cap and engage the insulator groove. The cap has a vertical fin which terminates with a horizontal flange, to which the angle iron conducting bar *C* is attached by bolts passing through slotted holes in the flange; expansion joints are provided in a similar manner. The angle iron pattern of conducting bar is selected for the reason that it gives a stability suitable for the purpose.

The vertical part may have a depth of say 1½ inches and thus provide for the main or downward strain, while the horizontal part may have a width of 1 inch and thus provide stability in a lateral direction so as to maintain a parallel position between the two bars.

Fig. 2 is a side elevation showing the trolley device, also a longitudinal section of the conduit showing its interior. The trolley device is composed of a trolley bar *H*, one end of which is attached to the truck frame by means of a universal joint *J* and extended back over the guard board *N* to near the end of the platform, where it is attached to a vertical axle $K^-$ by means of bearings $S' S^2$. The axle $K^-$ is slotted vertically on its left side and in this slot is placed the conduit plow *L*, it being held in position by a key *Q'*. The bearings $S' S^2$ have openings as shown at *S'*, Fig. 1 to correspond with the slot in the vertical axle $K^-$. This slot arrangement provides for detaching the conduit plow *L*, which is done by removing the key *Q'*. A check key $Q^2$ serves to lock the main key *Q'* in place.

To the lower end of the plow *L* is attached by means of a longitudinal joint *M* an insulated cross bar *N*, Fig. 1, to the ends of which are attached two trolley wheels $O' O^2$. The trolley wheels run on the vertical part of the two angle iron conducting bars $C' C^2$. The joint *M* having longitudinal axis, permits the trolley wheels to adapt themselves to the slight difference in levels of the two conducting bars. The conducting bars support almost the entire weight of the trolley device.

The trolley bar *H* and vertical axle $K^-$ maintain the conduit plow *L* in a vertical position, but permit entire freedom of movement in lateral and vertical directions. The conduit plow also has a rotary motion on its vertical axis by means of the journals $S' S^2$, which is necessary in order to steer the trolley wheels according to the curvature of the conducting bars. The steering device consists in a tiller bar $R' R^2$, Fig. 2, fulcrumed at its center *T* to the lower part of the slotted axle $K^-$ and formed as shown in the illustration. One end always engages in the slot and either end can be turned down into the slot according to the direction in which the car is to run.

When the car is to run toward the left the end *R'* is turned down into the slot as shown in Fig. 2. On entering a curve the tiller bar *R'* is turned by the curve of the conduit slot and this causes the conduit plow *L* to rotate accordingly and with it the axis *N* of the trolley wheels $O' O^2$, thus adjusting the trolley wheels for the curve slightly before they reach it. That is, the axis of the trolley wheels is shifted to a line slightly in advance of the radius of line the curve, and this position is maintained until the tiller *R'* enters straight line slot again, when the axis of the trolley wheel is brought back to a position at a right angle to the conducting bars. When the car is to run in the other direction—that is, toward the right—then the position of the tiller bar is reversed; that is, the end *R'* is turned up out of the conduit slot and this action causes the end *R* to engage in the conduit slot and thus give an advanced adjustment to the trolley wheels on entering curves in a right-hand direction, in the same manner as just explained for left-hand direction.

By this means a positive and independent steering device for the trolley wheels is provided, which does not depend on the wheel flanges as a steering device, as is usually the practice. The trolley will run in either direction; that is, it can be propelled in front of the car or can trail behind the car.

To the trolley wheels $O' O^2$ are connected insulated wires *1 2* which lead up through a channel in the plow *L* and terminate with insulated tubular connections $W' W^2$ at its upper end. The tubular connections are located almost entirely within the upper end of the plow and are thoroughly insulated from it; the outer ends of the insulating tubes $W' W^2$ only are visible. Flexible insulated wires *3 4* connect with these tubular connections by means of a short stem which is easily inserted or withdrawn. The wires *3* and *4* lead to the motor and controlling device on the car. The object of the insulated tubular connections for the conduit plow is to guard against short-circuit and accidents while attaching, detaching and shifting the plow.

In case of a conduit road connecting with an overhead trolley road where through car service is desired, the conduit plow must be dropped off and the overhead trolley put up. The conduit plow is disconnected by removing the key *Q'*, when it can be dropped out of the slotted axle $K^-$ and turned down into the conduit until its cross pin *P* rests on the conduit slot rails.

A Chicago syndicate, it is announced, has proposed to put in exchanges in Laporte, South Bend, Elkhart, Goshen, Lagrange, Ligonier, Warsaw, Columbia City and Fort Wayne. These cities are to be connected and a telephone instrument placed in all the public buildings of the cities along with private places where they are desired. The instruments are to be so arranged that anyone who desires to use them can by dropping a nickel in the slot talk with any patron in the different towns in the circuit.

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ANNOUNCEMENT is made that the action of the executive committee of the National Electric Light association at a meeting held in New York on September 11th in selecting Cleveland as the place for holding the next convention has been confirmed. It is now definitely settled that Cleveland is the place, and February 19, 20, 21, 1895, the time for holding the next meeting. That city has entertained the street railway men in a most hospitable manner, and, as the local representatives of the lighting interests expressed great eagerness to have the meeting held there, it may be expected that visitors will be well cared for.

THE transformation of the existing horse car lines of the three great street railway companies of Chicago into electric roads, in connection with the elevated electric railway work now under way in this city, has brought several large contracts to three of the electrical manufacturing companies of the country. The latest of these, closed last week, is noted on another page. The purchases of electrical machinery and appliances made by the traction companies of Chicago within the last six months probably amount, in the aggregate, to about $800,000, while more material will be necessary to operate all of the lines that are to be electrically equipped. It took a long time to introduce the electric railroad into Chicago, but it is going in now with a rush.

THE financial rewards of the profession of electrical engineering in Great Britain are not such as to tempt young men to equip themselves with an expensive technical education, if we may judge by a recent announcement in the *Electrical Engineer* of London. "The corporation of Cardiff," says that journal, "require an electrical engineer to take charge of their electricity works. Applications are to be addressed to J. L. Wheatley, town clerk, Town Hall, Cardiff, not later than October 22d. The salary offered is £3 per week." Cardiff is, we believe, the largest town in Wales, and possesses, it is to be presumed, a municipal plant of considerable importance. To offer a weekly salary of less than $15, the wage of an American lineman, for the services of an engineer competent to take charge of such a station is rather startling. We hope, however, that this is an exceptional instance of official "economy" rather than a general type.

THE constitutionality of the street car vestibule law in Ohio was upheld by the Supreme Court of that state in a decision handed down at Columbus on November 3d. The law was passed in April, 1893, and requires all companies to provide electric cars with vestibules to protect the motormen from the severity of the weather during the winter months. This has already been done voluntarily in several eastern cities, and a number of states, including Minnesota, have passed similar laws. It seems that the Ohio companies opposed the law, and the lower courts generally held that the statute was unconstitutional. This decision has now been reversed by the Supreme Court of the state, and the provisions of the law will be strictly enforced. There is no reason why the companies should not provide vestibule cars for the protection of motormen, nor is there any valid reason why the cable companies of Chicago should not enclose the grip cars in winter. On these lines the gripmen are exposed to the elements the whole year round. These companies can well afford to provide their employes suitable accommodations, and, moreover, they should be compelled to do so.

READERS of the WESTERN ELECTRICIAN will recall the interesting articles on "Electricity in Japan," written for this journal by Kunihiko Iwadare, and appearing in the closing months of 1892. Mr. Iwadare showed that his progressive countrymen had an experimental knowledge of modern electrical applications, and it is fair to presume that a proportionate advancement has been made since the articles were written. This experience has been of great advantage to the Japanese in the present war with China. One of their first actions was to take hold of the telegraph lines and stations in Southern Corea, and to turn them over to their own corps for operation, for immediate service. In China the telegraph lines have been cut down by the people, on the allegation that they caused drought, and are but now being painfully rebuilt. In Japan, on the contrary, the government has developed a land system of 26,000 miles, and has established several cable links between the islands. During the Satsuma rebellion of 1876 this service proved of great value. The military field-telegraphs of the Japanese army are modeled on European systems. The Japanese also make free use of the telephone, which caught their fancy from its earliest days, and they have also shown a marked partiality for the electric light. It is worthy of note, too, that the Japanese were quick to apply electricity to the operation of canals, by using motors to operate the locks.

DURING the political campaign just closed the practice of holding torchlight processions became a public nuisance. As a matter of course, the line of march on these occasions was always through the busiest parts of the city, and traffic of all kinds was temporarily suspended. Of course street car lines were crippled, and the people of the entire city were put to great inconvenience as a result. In many cases financial loss was suffered and serious delays caused. These political parades, by reason of their frequency during the last two months, impressed on many men the fact that all parades interfering with public traffic were public nuisances and should not be tolerated. If organizations persist in making public demonstrations of this character they should be restricted to such thoroughfares as are not occupied by street railway lines and do not cross streets having surface roads. In Chicago on several occasions the entire street railway system of the city has been completely paralyzed for several hours by parades. At times public demonstrations when not of a political character may be tolerated, although, generally speaking, the people would hail the day when such parades would be prohibited by law. Street railway managers will confer a favor on the public by securing the enactment of a law prohibiting parades that will interfere with the operation of street railway lines and seeing that it is strictly enforced.

IN the course of an interesting article on "Domestic Electric Lighting Plants," in the *Engineering Magazine* for November, Nelson W. Perry describes the advancement and numerous improvements that have been made in this special field in the last few years, which have made isolated plants for house lighting practicable. The problems encountered in this particular line are widely different from those met with in ordinary commercial work, as the condition are, of course, essentially different. Several typical plants are described by Mr. Perry, probably the most interesting being that owned by G. Morosini and used for lighting his residence at Riverdale, on the Hudson. This is said to be one of the largest and most complete plants of the kind in this country. It consists of two gasoline engines, belted each to a 10 horse power generator. These latter are connected with a switchboard, which is also double, so that either dynamo may be separately connected with the house circuits or with the storage battery; or they may be connected together in parallel with either the house circuits or the battery. The storage battery consists of two series, each of 60 cells, which, when connected in parallel, have a normal discharge rate of 70 amperes. This plant is installed in a small brick building some distance from the house. Except on special occasions when the full capacity of the plant is required, the lighting is done entirely from the storage battery; but on these special occasions both the battery and the dynamo are put into service. In charging the battery but one dynamo is used, and this is run so as to give a current of 73 amperes at from 125 to 150 volts. The charging of the battery occupies two or three hours per day, during which time only is the machinery usually in operation. This system is the result of considerable experiment and no little cost. Five years ago a plant of this kind was installed at the residence of Potter Palmer, Chicago, and it has been in successful operation ever since. It has been satisfactory in every respect, and probably has done more to inspire confidence in the storage battery among prospective purchasers than any other plant in the country.

ONE of the most significant indications of the great interest manifested all over the country in Tuesday's elections was the special effort made by the Chicago Telephone company to furnish free information to its subscribers on election night. The city returns were obtained by co-operation with the City Press association, which, as in former years, established its election headquarters in the city hall. From the state at large reports were secured from the state central committee of the Republican and Democratic parties, located respectively in the Grand Pacific Hotel and the Palmer House, which, of course, were supplied with the earliest information from the county and local political committees in the country districts. New York state and other eastern returns were obtained by long-distance telephone from the city of New York, two circuits being expressly reserved for this purpose.

The city, state and eastern returns thus secured were all turned into the central office of the company for the local service. Here a force of skilled operators telephoned them over the trunk circuits to each of the branch exchanges scattered throughout the city. In each subsidiary exchange, again, a number of picked operators transmitted the returns directly over the subscribers' calling circuits. Of course most of the business subscribers of the company had closed their offices for the day before the returns began to come in, so that the results were received mainly in hotels, clubs and private residences, where men—and ladies, too, in many instances—gathered to hear the news. The Chicago Telephone company has some nine or ten thousand subscribers, and of these from 1,200 to 1,500 took advantage of this special gratuitous service.

The new idea of collecting election returns and telephoning them to private subscribers had the effect of evolving a new form of social entertainment. Gentlemen having telephones in their homes felt themselves to be particularly fortunate, and a number of them gave "election night receptions," inviting their friends to pass a social evening, with the added zest of realizing that the country was saved or had gone to the dogs, according to the political predeliction of each guest.

The idea was received with enthusiasm, and although it was suspected that the rather unexpected generosity of the company was not uninfluenced by the prospect of possible competition in the telephone field, the extra service was nevertheless appreciated.

## Can the T Rail be Satisfactorily Used on Paved Streets?

By Strathearn Hendrie.

The tendency of the larger cities in this country—in fact, we might say in all the cities of this country—during the past ten or twelve years has been toward smoother and better paved streets, and the general public, watching the progress of its city officials, has become in many places impatient of the action of the street railway people in maintaining the old forms of rail, which make a ridge on the smooth surface of a first-class modern street in an American city. Our travelers have come home from England and the continent extolling the grooved rail, and our city officials have in many cases forced either the English grooved rail or its American modification upon the railway companies. No street railway man hankers after the grooved head before he gets it, or enjoys it after he has put it in, and he therefore fights its introduction, demanding to be left alone, as he was, with his center bearing or five inch tram head. What we would show him—and through and beyond him his public—is that he can progress in the direction of their desires for a smooth street, and can give them something even more satisfactory to them than their favorite grooved rail.

For the street railway man, questions of price, joints, quick delivery, competition, coal pile, and construction combine to recommend the T rail. The old argument for the tram head—that the steel paving for the three inches is a decent job of the paving, neither the officials nor the citizens will permit you to use anything else in the future. The main thing is to make your paving job a neat and good one. In three of the other cities, where there is at present no T rail, but which are blessed with enlightened city officials, the T rail is about to be made a requirement on the companies.

Modern street railway construction and street paving imply a broken stone, concrete or other solid foundation, a high girder or T rail and a brick, asphalt or granite surface to the street in the larger cities, or cedar block, cobble or macadam in the smaller ones.

Asphalt or macadam can be paved as easily to a T rail as to any other. They should be laid flush, and room should be made for the flange by running a railroad freight car, or other car having a larger flange that the street car, over the track before it is opened for traffic. Bricks are now moulded by many paving brick manufacturers to fit girder and T rails, those for the latter allowing a space for the flange of the car wheel. Whether it is more expensive to chip the corners of granite or Medina blocks or to leave them intact a short distance from the head of the rail and fill the space thus made with asphalt, creosoted wood or concrete, is open to question, but in either case a first class job can be made. The writer is familiar with two excellent pieces of fifty-six pound T rail construction on chairs, in one of which the pavement consists of six-inch cedar blocks, and in the other of small three or four inch cobble stones, both paved close to the rail with no filling.

It may be useful in your arguments with city officials in favor of a T rail as against a grooved girder, to insist that a T rail is a girder rail with a head differing less from that of the grooved girder than this does from the tram or center bearing head. Also the substitution, in this country, of the steel base and upright member of the girder for the wooden stringer, took place before the introduction of the grooved rail, and was due to entirely different causes, and certainly has not been brought about by any demand for smooth streets originating with the cities or citizens. Such substitution is equivalent to that of steel for wood in buildings. The girder is an established fact; its grooved head, we hope, is merely a passing fancy. The grooved rail might easily be a big-headed T out of which a piece corresponding to the groove has been planed. This can easily be shown by reference to cross-sections. And we should bear in mind that if we hope to peacefully and with good feeling avoid the use of the grooved rail we must do so, not by demanding obstinately what we know in our inmost minds to be reasonably objectionable, to be bad practice, to be obsolete, but by presenting to the public, and educating it up to it, a rail which shall, from its point of view, be as far ahead of the grooved rail as that is ahead of the tram or center bearing rail. And we should also bear in mind that the public will demand, and in the long run will secure, streets satisfactory to itself.

T RAIL ON PAVED STREETS.

| Place. | Company. | RAIL IN PAVED STREETS | | Construction | PAVEMENT. | | Filling. | REMARKS. |
|---|---|---|---|---|---|---|---|---|
| | | Miles T. rail. | Other rail. Weight. Height. | | Inside. | Outside. | | |
| Augusta, Ga. | Augusta Ry. Co | .5 | 3.5 56 lb. 3½" | Ties 3 ft centers, steel chairs. | Brick. | 3 in. brick, then asphalt. | None. | Public and officials think it better than girder. |
| Bay City, Mich. | Bay Cities Con. Ry. Co. | 8 | 11 60 lb 6" | | | | Oak strip, gravel, etc. | City Engineer and B. of P. W. think it the only rail. |
| Boston, Mass. | West End St. Ry. Co. | 24 | 215 35 to 100 lb 1½" to 9" | Largely 6 ft rail on stringers and 9 in. on ties with tie plate. | Granite block. | Same. | | City officials and the public are not in favor of it. |
| Columbus, O. | Columbus St. Ry. Co. | .5 | 54.5 60 lb. 6" | Ties 2 ft. centers, broken stone ballast, | Brick. | Same. | Hardwood covered with coal tar. | No complaint; more will be laid |
| Denver, Colo | Denver City Cable Ry. Co. | 6 | 4" | Cable, yokes 4 ft. apart. | Asphalt with stone toothing. | Same. | None. | Makes good street. |
| Denver, Colo. | Denver Cons. Tramway Co. | 6.75 | 48 to 72 lb. 3⅞" & 6" | 6 in concrete under ties; concrete between ties. | Stone blocks, next rail, then asph. | Stone block. | Oak strip bevel to fit. | |
| Des Moines, Ia. | Des Moines City Ry. Co. | 2 | 25.23 60 lb. 6" | Spiked to ties. | Brick. | | | Public and city officials like it |
| Duluth, Minn. | Duluth St. Ry. Co. | 16 | 10 5¾" | Ties 2 ft centers, oak stringers. | Cedar block. | Same. | Block cut or notched. | All like it. |
| Ft. Wayne, Ind. | Ft. Wayne Elec. Ry. Co. | 8 | 7 60 lb. 6" | Ties 2 ft.; tie rods 10 ft. | Brick block, cobblestone. | | | Company now reconstructing entirely with T rail. |
| Houston, Tex. | Houston City St. Ry. Co. | 9 | 1 45 lb 4¾" | Ties and chairs and stringers. | Brick, gravel, cypress bois d'arc, rock | Same. | Concrete. | Gives satisfaction. |
| Lincoln, Neb. | Lincoln St. Ry. Co. | 15 | 5¼" | Ties 2 ft. centers. | Brick, cedar. | Same. | Sand with brick. | Have only two curves now, but intend to lay track |
| London, Ont. | London St. Ry. Co. | 1 | 11.5 56 lb 4" | Cedar ties, gravel and ballast. | Gravel. | Macadam. | | Not favored. (Note—Pavement is not good.) |
| Marinette, Wis. | Marinette Gas, E. Light & St. Ry. Co. | 4 | 40 & 60 lb 3½" & 6" | | Wood block. | Same. | Wooden strip to fit | All well pleased now. |
| Minn'polis, Minn | Twin City Rapid Transit Co. | 5 | .5 60 lb 5¾" | | Cedar or granite. | Same. | Pine or oak strip. | City engineers approve. |
| New Haven, Conn | Winchester Ave. R. R. Co. | 14 | 52 to 72 lb. 4¼" & 4¾" | On chairs and ties. | Half block, half cobble. | Same. | | Common Council will have nothing else. |
| Norwalk, Conn. | Norwalk St. Ry. Co. | 3 | 60 lb. 6" | Three brace chairs to each rail. | Blocks and cobbles. | Blocks and macadam. | | Gives satisfaction. |
| Norwich, Conn. | Norwich St. Ry. Co. | 1.2 | 48 lb. 4" | Chairs and stringers. | | | Gravel. | Not favored much. |
| Port Huron, Mich. | City Electric Ry Co. | 5 | 45 lb. | Cedar ties, pine stringers. | Cedar block. | Same. | Oak strip inside, pine strip outside. | Gives satisfaction. |
| Racine, Wis. | Belle City St. Ry. Co. | .227 | 2.773 4⅜" | | Brick. | | | Public and officials like it |
| Salt Lake City, Utah. | Salt Lake City R. R Co. | 3 | 72 lb. 6" | | Sandstone block. | Same. | Sand. | Public and city officials well satisfied. |
| Savannah, Ga. | City & Suburban Ry. Co. | .1 | 7 | Chairs or stringers. | | | | Not favored. |
| Springfield, Ill | Springfield Cons Ry Co. | 22 | 40 & 62 lb. | | Beveled brick or block. | | | Gives satisfaction. Authorized by City Council. |
| Springfield, Mass. | Springfield St. Ry. Co. | 15 | 56 lb. 4" & 4¼" | On stringers and on ties and chairs | Granite and cobble. | Granite and macadam. | Asphalt & brick. | No complaint; evidently satisfactory. |
| Waterbury, Conn. | Waterbury Traction Co. | 8 | 6" & 7" | Spiked; ties 2 ft. | Belgian block for 7 in. rail; cobble for 6 in. | Belgian block. | None. | None better, when properly laid and paved to. |
| Windsor, Ont. | Sandwich, Windsor & Amherstburg Ry. | 3 | 1 56 lb. 4¼" | Steel chairs; ties bedded in gravel, then inch board and block paving. | Cedar block. | Same. | None. | Preferred to girder rail. |
| Wyandotte, Mich. | Wyandotte & Detroit River Ry | 2 | 56 lb. 4¾" | On broken stone. | Macadam. | Same | None | No objections. |

The cheapest in the end—no longer holds good in these days of good street pavements and rapid transit. Wagon traffic goes where it belongs—on the side of the street. To those who can still use the clean headed, old center bearing rail, we can only say, "You lucky dogs;" to most of us it is lost forever. As a substitute for this, where old grants are being renewed or new ones made, the grooved headed rail has been in many places hastily, and, we believe, unadvisedly required. While the suggestion of a T rail, for use in paved streets in cities, is startling to the average citizen, alderman or city engineer, and is in most cases impatiently rejected by them, yet we must recollect that the mention of a rail, such as steam roads use, calls up in their minds the idea of four or five inches of steel standing up above the street and of dilapidated plank crossings with half drawn spikes, and we should go patiently to work to teach them that as there is more than one way to supply motive power to a car, so there is more than one way of putting a rail in the street.

To aid you in this, we have prepared a list of twenty-six cities in which the T rail is used, with remarks thereon kindly furnished this committee by the railway companies in answer to a list of questions sent out; and we might also say that there are over fifty others members of this association, whose roads are reported in the railway publications, as being partly or wholly constructed of T rail, who declined or neglected to answer the inquiries of your committee. The general consensus of opinion of the twenty-six roads referred to, and of the officials of the cities in which they run, is that if you can once get down a hundred yards of T rail and make

1. Read befor the American Street Railway association, Atlanta, Ga., October 18, 1894.

The lot of the stockholder in an electric lighting company is not always a happy one. This is sadly illustrated by the fact that the original stockholders of the Brockport, N. Y., Electric Light company will receive from $12 to $15 on each $100 invested by them. The plant was recently sold on a mortgage foreclosure.

## The Knapp Failure.

Receiver Lucas appeared in court last week and asked for a general order to sell the tools and machinery of the Knapp Electrical Works. The creditors' association opposed the issuing of the order unless it were conditioned so that three-quarters of the inventory price should be realized. The receiver represented that much of the shop material was considerably worn and that it would be impossible to secure 75 per cent. of the scheduled value for it. The judge finally entered an order authorizing the sale, provided the receiver realized an average price of 50 per cent. of the inventory value. Mr. Lucas had obtained a previous court order allowing him to sell the stock and merchandise at not less than 75 per cent. of the estimates in the inventory.

Many of the facts presented in the report of Auditor Bard are summarized in the affidavit printed in the last issue of the Western Electrician. Mr. Bard, in concluding his report, makes the following estimates, which are of particular interest to the unsecured creditors:

In conclusion I beg to submit two estimates of the real value of the assets, or the amount that may be realized for the unsecured creditors. The first is based upon an arbitrary reduction of 25 per cent. on the face of certain assets, and is as follows:

*Assets.*

| | |
|---|---|
| Merchandise (25 per cent. discount from inventory) | $41,982.68 |
| Cash | 254.04 |
| Tools and machinery (25 per cent. off) | 14,497.67 |
| Furniture and fixtures (25 per cent. off) | 2,090.60 |
| Bills receivable | 623.79 |
| Patents (25 per cent. off) | 4,875.24 |
| Accounts receivable ($33,968.48 off) | 13,930.07 |
| Cicero bonds at 80 per cent | 2,640.00 |
| Claim against Safety company (offset to notes held by them) | 16,550.48 |
| | $97,444.57 |
| Deduct receiver's expenses | 12,000.00 |
| | $85,444.57 |
| Deduct F. M. Knapp judgment | 27,989.50 |
| | $57,455.07 |

*Liabilities.*

| | |
|---|---|
| Bills payable | $54,135.48 |
| Accounts payable | 29,082.61 |
| | $83,218.09 |

Per cent. of assets to liabilities, 69 per cent. The second

estimate is based upon an arbitrary discount in the same items of 50 per cent. instead of 25 per cent. and results in a per cent. of assets to liabilities of 44 per cent.

The receiver's expenses are estimated in each case at $1,000 per month for one year.

It will be remembered that the first committee appointed by the creditors for the purpose of reporting upon the possibility of reorganizing the company, consisting of F. S. Terry, Geo. C. Bailey and Geo. W. Conover, reported about September 1st. The committee estimated that the receiver would probably realize as follows: From accounts, $9,139.80; merchandise in store, $22,758.63; machinery, $2,650; shop material, $7,510.89. Deducting for receiver's expenses in closing out the estate $12,000, would leave the net amount which would be realized $30,059.32, or about the amount of the judgment of F. M. Knapp. It was the opinion of the committee that the unsecured creditors would not receive anything on their claims, and it could not find that there was any basis on which the business could be reorganized.

## Feeder and Main Patent Litigation.

The last development in the litigation between the Westinghouse and Edison interests over the feeder and main litigation is the filing of the following order made by Judge Green in the United States Circuit Court for the District of New Jersey, held at Trenton, October 26th:

Decree herein having been entered the 25th day of April, 1893 ..... and the transcript of the record having been taken into the United States Circuit Court of Appeals for the Third Circuit by virtue of an appeal, and the said United States Circuit Court of Appeals having on consideration thereof on the 18th day of September, 1894,

Ordered, adjudged and decreed that the said decree of this court be reversed with costs and the mandate of the said United States Circuit Court of Appeals dated the 18th day of October, 1894, being now here before this court, on motion of Kerr & Curtis, Esqs., soliciters for defendant,

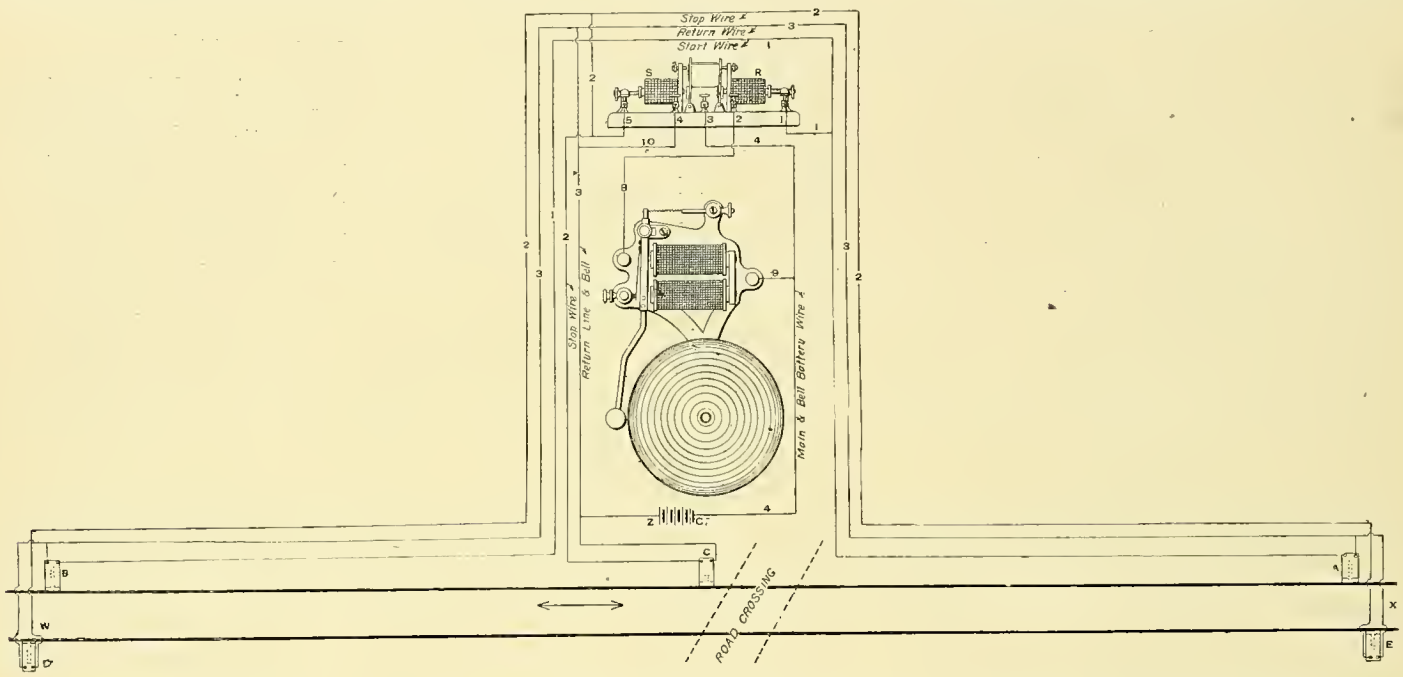
It is ordered that said mandate be filed herein and that the said decree of the said United States Circuit Court of Appeals be and the same hereby is made the decree of this court, and it is further ordered that defendant have judgment against the complainant, the Edison Electric Light company, for the sum of forty-two dollars and sixty-five cents ($42.65) amount of costs taxed herein by the clerk of the United States Circuit Court of Appeals, and have execution therefor; also that defendant have judgment against the complainant, the Edison Electric Light company, for the further sum of six thousand four hundred and eleven dollars and fifty-seven cents ($6,411.57) amount of costs taxed by the clerk of this court herein, and have execution therefor.

## Signal for Railway Crossings.

In the accompanying cut is illustrated the characteristic features of an electrical signaling device now in use upon the Baltimore & Ohio, Chesapeake & Ohio, Long Island, and New York and New England Railroad companies' lines, which makes it unnecessary to employ watchmen and gates upon grade crossings. This device was invented by Charles Selden, superintendent of telegraph of the B. & O., and H. V. Riley, both of whom are experienced railway men.

In the apparatus used on single track, there is an opening wire 2, and a closing wire 1, extending from the crossing in each direction to the point where it is desired to have approaching trains set the bell ringing. The closing wire completing the circuit which causes the bell to ring is connected to the track boxes marked *A* and *B*. The opening circuit, which causes the bell to cease ringing, is connected to the track boxes marked *C*, *D* and *E*. These track boxes are suspended between the ties outside of the rail. The short end of the lever within the box is under the base of the rail and in contact therewith, and when an engine or train passes over the track the rail is slightly depressed, causing the lever to make the electric contact and operate the signal.

The manner in which the signal is operated on single track is as follows: A train starting at *X* will cause the lever in box *E* to make contact, closing the stop magnet *S* and holding the armature against it. The circuit enters the magnet *S* at 5 and goes to battery through post 3 and wire 4. At the next instant the lever in box *A* is depressed, closing magnet *R* (through post 1, out at post 3 and by wire 4 to battery). This has a tendency to attract the armature in the other direction; but the stop magnet *S* being the stronger of the two within the relay, the armature remains as first placed until the last wheel of the engine or train has passed off of the box *E*; then the wheels continue to depress the lever of box *A*, thus closing the circuit through the magnet *R*, attracting the armature, closing the local points, making the circuit through post 2, wires 8 and 9 to battery and return through wires 3 and 10. This causes the bell to ring. The bell will continue ringing until such time as another stop box, placed where it may be desired, is reached, when the current will again be diverted to the stop magnet of the relay and the bell will cease ringing. A train entering at point *W* will have exactly the same effect.




SIGNAL FOR RAILWAY CROSSINGS.

The accompanying diagram, which is reproduced from the *Railroad Gazette*, shows a metallic circuit; the signal will also work with a grounded circuit. The employment of grounded or metallic circuits is entirely optional with the user.

It is claimed that a record kept upon one division of the B. & O. road shows that there were 700,000 operations of this signal without a failure.

## Affairs of the General Electric Company.

It is reported that over 4,000 men are now employed in the Schenectady shops of the General Electric company. During the summer the railway branch of the business has been particularly active, and it is said that in May more railway generators and motors were sold than in any previous month in the company's history. It has been decided to transfer the manufacture of all railway motors and small railway generators to the Lynn factory. With the present demand for this class of machinery throughout the country, this work will be almost sufficient to reinstate the Lynn shops to their former importance as an electrical manufacturing center.

The contract between the city of Quincy, Ill., and the Thomson-Houston Electric Light company was signed on October 26th. Under it the company is paid $75 per arc light for all furnished, excepting the lights in Washington, Riverview, Madison and Franklin parks and city hall. The contract made is for five years.

## Important Chicago Electric Railway Contract.

C. T. Yerkes, for the North and West Side Street Railroad companies of Chicago, has entered into contract with the General Electric company for three 1,200 horse power generators and 600 motors, to be used in connection with the Siemens & Halske generators now building for the equipment of the present horse car lines of these great street railway systems with electric power. It is announced that the General Electric company will also supply additional equipments at a later date. The machinery now under contract must all be delivered in Chicago prior to March 1st. This deal was closed in New York by Mr. Yerkes, as president of the Chicago companies, and Messrs. Coffin and Clark of the General Electric company. In referring to this contract the *Chicago Journal* says that "should the returns be such as to warrant it, the cable systems may also be trolleyed," and adds:

It will be remembered that the Lake Street Elevated is controlled by C. T. Yerkes. It is said that this road will also be equipped with electricity. The "L" company will lease its power from the West Chicago Street Railroad company. Power houses are being constructed on the North and West Sides, and they will be ready for operation about March 1st. The General Electric company will deliver the motors and generators on order, and equip the cars so that the lines can all be in operation on the completion of the power houses. The electrical construction is intended to more than meet any elevated competition. The results in the East have been very favorable. For the first twenty-five days of October the Philadelphia Traction company's earnings increased on an average $2,600 a day. Philadelphians are largely interested in the Yerkes roads, having acquired their stock quite recently on the prospects for electrical equipment.

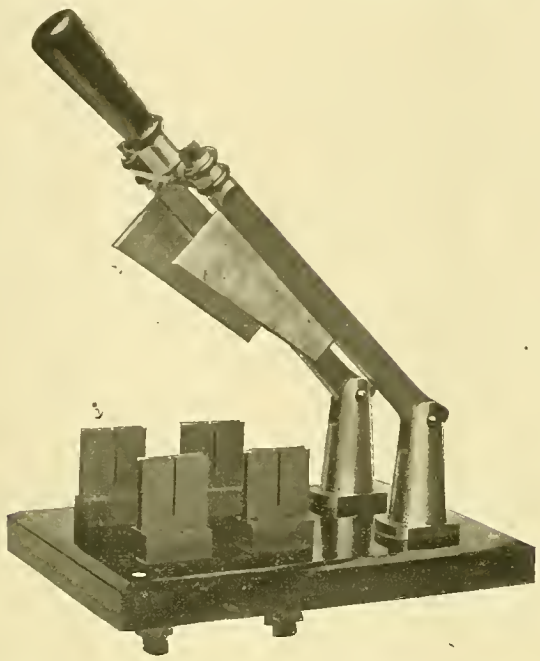
## A Boston Suggestion.

General Francis A. Walker, president of the Massachusetts Institute of Technology, has suggested to the trustees of the Franklin fund of Boston that the money be applied to the creation of a department of electricity at the "Tech." The general attended the last meeting of the trustees and laid before them the good that could be done by appropriating the fund to such purpose. "I did not antagonize the devoting the fund to any other use the trustees might deem best," said General Walker when interrogated about it, "but offered what I had to say as a suggestion of what might be done. The Institute of Technology was one of the first schools in the country to make electricity a branch of study, and has undoubtedly the largest class in it in the world. I do not know that the trustees have the right to devote the fund to any other use than the trade school that has been talked of, as I have not read the provisions governing it. But it seemed as though it would be a decidedly appropriate application, when Franklin's interest in and investigation of electrical phenomena is remembered. To found a trade school means the expenditure of a large amount for land and the necessary building, while the Institute has the building and room for the department I spoke of. But I have no wish to antagonize any other project, as I before said. I spoke of the foundation of an electrical department as one way in which it seemed to me a use could be made of the money at command that would be of great future benefit. The fund is a large one—$365,000—and in view of the growing importance of electricity to the world and the value of an understanding of its laws, it seemed to me quite a proper use to put it to."

Nash Bros.' electric light plant and the Spencer electric light plant at Centralia, Wis., have been consolidated.

## Jack-knife and Motor Switches.

The accompanying cut represents a new switch placed on the market by the Tecbuic Electrical Works of Philadelphia. This concern announces that in placing these switches on the market it has been its aim to furnish a strong, reliable switch of neat appearance for use in high-class work. The switches are made with spring standards, hard rolled copper blades carefully set in red brass arms, jaws of copper set in and riveted to the connection blocks,



JACK-KNIFE AND MOTOR SWITCHES.

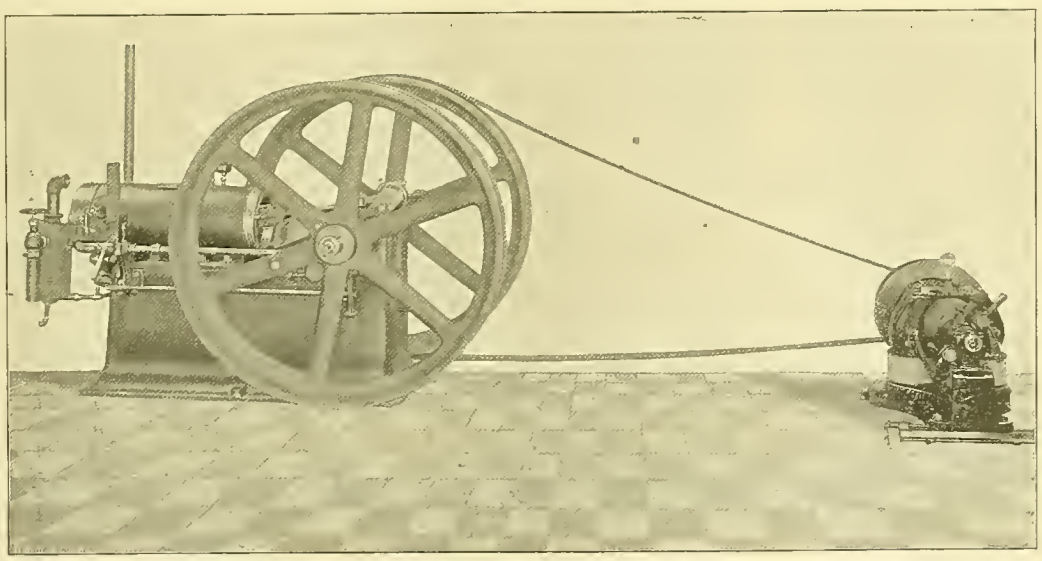
and separable connectors for either back or front connections. The switches are mounted on black enameled or marbleized slate, and all exposed metal work is finished true, polished and lacquered. In plain finish the metal work is dipped and mounted on plain slate. The motor switch has arm and blade made in one piece, friction standard, front connections, and is intended to stand hard usage. The metal work is dipped finish, mounted on plain slate.

## Lewis Gas Engine.

American electrical engineers are more and more turning their attention to the employment of gas engines for driving dynamos in small electric lighting plants. In England and Germany this subject has been more carefully investigated, and the proportion of gas engine electrical plants is much higher in those countries than in the United States. Lewis engine seems to have solved this problem satisfactorily. In the first place, the engine is heavy and well proportioned; the fly wheels of such weight that they will give a variation of less than 5 per cent. in the cycle. A throttling governor is used, and it takes a charge at every other revolution; this insures an explosion at every other revolution, which gives a much steadier motion than it is possible to obtain in the usual governors. The Lewis engine also has a unique way of making its gas. It does not attempt to put the gasoline into the cylinder, but converts it into gas before it is admitted, where it is compressed and ignited by means of either a tube or an electric spark.

The advantages of gas engines for isolated plants are: First, economy; second, the fact that they are always ready to start up on a moment's notice; third, the avoidance of all dirt and smoke that is the accompaniment of a steam plant. It seems now to be an assured mechanical fact that a gas engine can be used for incandescent lighting with perfect success and satisfaction.

To show the economy of isolated plants using gas engines, the company points out that at the usual charge of one cent per lamp hour 100 lamps burned on an average of four hours per day will cost $104 per month. By the use of an isolated plant consisting of engine and dynamo, the same amount of light, including cost of gasoline, lamp renewals, oil, etc., would cost about $26, varying somewhat with local conditions. Arc lamps, either alone or in connection with incandescents, can be readily operated, and, owing to the low cost at which the current is produced, electric heating and cooking devices can be used in many cases where now the cost of operation is prohibitive. The engine is especially adapted to charging storage batteries for house lighting, electric launches, etc.



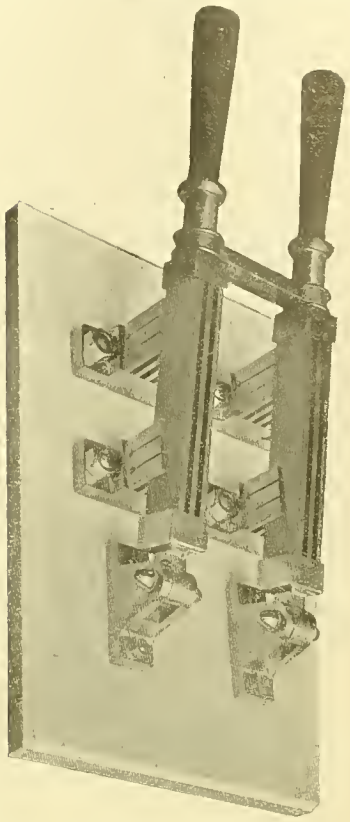
LEWIS GAS ENGINE.

American manufacturers are now directing their attention to this promising field, and none with better prospects of success than the Webster Manufacturing company of Chicago, which produces the Lewis gas engine, shown belted to a dynamo in the accompanying cut.

It was for a long time a matter of doubt if gas engines could ever be produced with sufficiently nice regulation to answer to run dynamos for electric lighting purposes. The

## Large Capacity Switch.

The accompanying illustration shows a new style of switch for work requiring a large carrying capacity, which has been recently introduced by J. Grant High & Co., 123 North Third street, Philadelphia. A novel feature of this



LARGE CAPACITY SWITCH.

switch is the construction of the blades and jaws. The former, as will be noted in the illustration, are made up of sections, thus allowing means of perfect contact and ventilation, and at the same time avoiding the usual bulky appearance of switches of the same carrying capacity. The jaws are specially designed to form a perfect contact by being made in sections longitudinally and divided transversely. This style of switch is made in sizes ranging from 700 to 10,000 amperes.

## Litigation Over Carbon Filament.

The controversy over the patent for an improvement in incandescent lamps, in the use of a carbon made from fibrous material, and in the form of an arch, horseshoe, or loop, reached the last stage of litigation last week when it occupied the attention of the United States Supreme Court. The case was on appeal from the judgment of the Circuit Court for the Western District of Pennsylvania, announced by the late Associate Justice Bradley and Judge McKenna, on October 5, 1889, the parties to the suit being the Consolidated Electric Light company (successor to the Sawyer-Man company) and the McKeesport Gas company, a licensee of the Edison company. A final decree, holding that the patent issued to Sawyer and Man in 1885 was invalid, was entered

October 10, 1890. From this decree the Consolidated company appealed.

The details of the contest over the issue of the patent and the subsequent litigation form an interesting chapter in the history of the development of incandescent lighting. From the record in the case (comprising over 2,800 pages of printed matter) and the briefs of counsel, it appears that Sawyer and Man made what is claimed to have been a practically successful discovery of a fibrous carbon material in March, 1878, but as explained by their attorney, no application was made for the issuance of a patent thereon at that time. In October, 1879, Edison discovered the same, or a similar substance, and applied for a patent December 11th following. A description of Edison's lamp and carbon was published ten days later, and on the 9th of January, 1880, Sawyer and Man filed their application for a patent. Three different decisions were rendered by the Patent Office officials, the first and last, by the principal examiner, to whom the case was referred, and the Commissioner of Patents, being in favor of Sawyer and Man, and one decision by the board of principal examiners, in favor of Edison. The contest here lasted five years, and resulted, as stated, in the issue of a patent to Sawyer and Man. In 1887 the Consolidated company, to which the Sawyer and Man patent had been transferred, brought suit against the McKeesport company, alleging infringement of the patent. The case was defended by the Edison company, whose lamps the McKeesport company were using. It set up that Edison's discovery was prior to that of Sawyer and Man; that Sawyer and Man did not apply for a patent until after the publication of Edison's device; that Edison had been successful in developing the light so as to be commercially successful; and various decisions of the courts, both in the United States and Europe, were quoted to show that Edison created the art of incandescent lighting.

The briefs of counsel in the case—Thomas B. Kerr and Leonard E. Curtis for the Consolidated company, and Frederick P. Fish and Richard N. Dyer for the Edison company—are books of about 300 pages each, and they contain an epitome of the history of the art of electric lighting which would probably secure their introduction as text books on the subject if the authors so desired.—*Washington Post.*

## Extensive Trolley System.

A franchise for the construction of an electric railroad in the town of Milton and the village of Ballston Spa, N. Y., has been awarded to the Boston Electrical Construction company. Work will be begun at once, so that the road will be in running order August 1, 1895. If the ideas of the company are finally carried out there will be a belt line running from Ballston Spa to Rock City Falls, thence to Jamesville, easterly to Greenfield Center and Saratoga Springs, and thence south to Ballston Spa. The company proposes to run its cars every hour during the daytime throughout the year, Sunday excepted.

The road will be of the standard gauge and will run ordinary freight cars direct from the large paper mills at Rock City Falls to New York city without breaking bulk. It will also have passenger equipments. The cost will be about $150,000. The new road, its projectors claim, will be the beginning of a system of electric roads connecting Troy, Albany, Schenectady, Amsterdam, Broadalbin, Johnstown, Gloversville, Rock City Falls, Saratoga, Ballston, Mechanicville, and possibly other cities or villages. The motors to be used on the first road, for which a franchise has just been granted, will be of 100 horse power each and will be capable of drawing several loaded freight cars. The tracks will be laid from the Delaware & Hudson road in Ballston Spa.

## Manners Over the Telephone.

[From the *Philadelphia Times.*]

"You didn't know, did you, that manners can be conveyed by wire? I can tell by each one of the people who talks to me just what his disposition is," says the brunette "Central," "and how he treats his clerks and employes, or, if he is an employe, just what sort of a fellow he is. The 'phone sharpens most people's voices a little, I know, but I'm not meaning that; it is their way of talking. I don't mean, of course, that the slow man at the 'phone is slow in his business. But I can always tell if he is a gentleman. People who would be polite to me if they saw me," continued this young empress of a clerk, who knows the dignity of her personality, "are not in this reckoning. They are talking to an unknown creature, and by the way they speak to it at the other end of the wire I get to know what sort of people they are."

## BOOK TABLE.

ELECTRIC LIGHTING PLANTS; THEIR COST AND OPERATION. By William J. Buckley. Price, cloth, $2.00; paper, $1.00. Wm. Johnston Printing company.

The purpose of this work, as stated by the author, is to give intending purchasers of lighting plants such details as may aid them in forming a fair estimate of the cost of construction and operation of their proposed station. As mentioned in the introduction, many books have been written for the engineer, fireman, dynamo tender and wireman, but few for the buyer, whose investment gives them employment; and it is the hope of the writer that the data given may aid the purchaser in the prevention of some of the usual mistakes in the first construction of his lighting plant or assist him in the increase of the economy of the operation. Data and suggestions on depreciation, building, coal, crude oil, natural gas, wood, water power, labor, boilers, trimmings, condensers, foundations, piping, connections, dynamos, incandescent lamps, incandescent arc lamps, alternating arc lamps, transformers, instruments, cost of complete plants, stock room, contract blanks, belting, rope transmission, shafting, pillow blocks, pulleys, overhead circuits, current distribution, pole line, wire and insulation are all conveniently arranged under separate headings; and their cost, maintenance and various efficiencies are, from the buyer's point of view, intelligently and minutely gone into. Conveniently arranged tables giving the cost of every item entering in the construction of the electric light plant are given, together with data valuable not only to the buyer, but to the engineer and operator.

Tables giving the average cost per lamp per month of arc and incandescent lighting, equivalant rates of gas and electric light, and cost per hour of fuel and labor in stations of different capacities, are of particular merit. Charts showing the various efficiencies of different types of engines under varying loads and steam pressures are presented; one chart showing the comparative efficiencies of high speed and Corliss engines being especially valuable to the non-technical buyer, as it gives the information which enables him to intelligently select the engine best suited to his requirements.

The cost of erecting arc and incandescent plants is tabulated in the itemized form of the rules of the National Board of Fire Underwriters, instruction to employes, the report of the committee on data of the National Electric Light association, standard rules for electrical construction and operation adopted at the Washington convention, March 1, 1894, are given in full.

Lists of cities lighted by private contract, with the number of lamps per year and their lighting schedule, together with reports of cities owning and operating their own lighting plants, are given. The diagrams of the connections of dynamos, lamps, switches, meters and transformers will be found of value to the operator.

The primary wiring tables of alternating current of different pressures are entirely original, as they provide for the impedence of the alternating current in large conductors as computed by A. E. Kennelly, and designate nothing larger than No. 3 wire, but employ a number of wires when the capacity required is larger than No. 3 B. & S. gauge.

At the close of the book diagrams of twenty working drawings or floor plans of station will be found that combine the different methods of belting direct and with line shafting under varying conditions, and which should enable the purchaser to evolve the plan best suited to the capacity of his station.

The frankness shown by Mr. Buckley in announcing in the introduction to the work that the only apparatus referred to in the book is that of Fort Wayne Electric corporation, with which he is connected, at once gains the confidence of the reader

CENTRAL STATION BOOKKEEPING AND SUGGESTED FORMS. WITH AN APPENDIX FOR STREET RAILWAYS. By Horatio A. Foster, Mem. A. I. E. E., New York: The W. J. Johnston company, 253 Broadway. Cloth. 139 pages. 75 forms and diagrams. Price, $2.50.

The book contains diagrams for the organization of the staff of electrical central stations, the classification of accounts and reports and includes sample forms for every department. As the name indicates, the work is devoted mainly to the accounting department, both of central stations and street railways, and outlines a complete scheme for its organization and routine which will enable the management to determine at any moment the condition of business, and particularly the unit cost of the generation and distribution of current. The forms were devised after an examination of several hundred in practical use in many stations, and are intended by the author to embody the best points of all. Many forms are of actual size in width, and printed on paper specially ruled, so that they may be used in ordering. In an appendix is furnished a classification of accounts of electric street railways, together with instructions, forms of books, etc., necessary to carry it out.

The importance of keeping a complete record of the costs of operation and management can scarcely be exaggerated. No central station manager is prepared to do business in times of close competition with gas and other companies until he knows the cost of every item going to make up the total unit cost of supplying the electric current to his customers. It is in order to enable him to put his business on this basis that this work has been written.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, November 3.—Brooklyn people are considerably exercised over the attempt of the Nassau Electric Railroad company to cross the Ocean Parkway at grade. A tunnel has been proposed, but it is stated that the company has obtained permission to construct a temporary surface crossing, and it is feared that if the company once secured the privilege of running on the surface it would postpone the construction of its tunnel indefinitely. On the other hand, the positive assertion is made that no permission is to be grantad to the company to run trolley cars across the boulevard. Permission has been given by Park Commissioner Squier for the company to build a tunnel under the parkway. When the company shows that it is earnest in its purpose to build this tunnel, and actually begins its work, it is expected that a permit will be granted to it to run its cars from one side of the boulevard to the other by means of horses. This will be done for the purpose of accommodating people using the cars. This is the company, by the way, that is experiencing such strenuous opposition in endeavoring to run its cars through Marcy avenue to reach the Broadway ferries.

James B. McGiffert, who died a few days ago in Elizabeth, N. J., had been interested in electrical enterprises for many years. Mr. McGiffert was a native of Hudson, N. Y. He graduated at Hamilton College, taught school as a principal in Northern New York, and afterward became a chemist in Hudson. He took a deep interest in electricity, and was made superintendent of the electric works in Hudson eight years ago. He went to Elizabeth in 1890 and organized the Suburban Electric Light company. It bought out the electric plant there and built a new one that supplies all the towns on the line of the Jersey Central as far as Plainfield with electric light. Mr. McGiffert was also one of the incorporators, the secretary and a heavy stockholder in the Suburban Electric Railway company, that intends operating an electric road from Plainfield to Elizabeth. He was thirty-seven years old, and leaves a wife and two children.

Joseph H. Reall explained to a meeting of capitalists of New York, New Jersey and Philadelphia, at a meeting in the latter city, the maps and plans showing the proposed electric road of the New York & Philadelphia Traction company. It was stated that all the necessary rights of way had been secured, and that surveyors are now going over the route. The intention is to build the road in sections and operate each section as soon as it is constructed. The plans of the company are to construct and control a system of about 200 miles. In addition to the lines to be constructed, it is intended to consolidate a number of desirable local roads now in operation in the territory covered by the company. Beside passengers, the company expects to carry express, mail and freight.

The Suburban Traction company of Orange is making an effort to keep out of the hands of a receiver. On Thursday it announced that it could not meet its obligations. The board of directors have agreed upon a plan of action which, if carried out, will prevent a foreclosure of the property. The large bondholders agreed to meet an assessment sufficient to discharge one-half of the floating debt and furnish funds to equip that part of the road in East Orange and Bloomfield with electricity, provided the creditors of the company agree to accept fifty cents on the dollar for their claims. The principal cause of the company's trouble was the accident which occurred last August on the Eagle Rock section of the road. As a result of that accident suits aggregating $172,000 have been brought against the company. Many of the claims are preposterous, only one or two of the persons who were injured having been seriously hurt. The effect of the accident was to frighten off capitalists with whom the company had been negotiating, and who intended to advance a large amount to enable it to liquidate its indebtedness and equip its extensions with electricity.

George W. Patterson, the Chicago boy who carried into practice the idea of swinging electrically illuminated Indian clubs, with changing effects, has recently attracted considerable attention at one of the music halls in this city. Mr. Patterson, who possesses a practical knowledge of applied electricity, has elaborated his "act" considerably of late, and now sings a song, "The Lightning King," making his own lightning as he goes along. His specialty is ingeniously worked up and is deservedly popular. W. F. O.

## St. Louis, Mo.

ST. LOUIS, November 3.—The Bell Telephone company of Missouri has just finished the installation of an interior telephone system in the new St. Nicholas Hotel of this city. This system takes the place of the ordinary annunciator. The various rooms and departments of the hotel are in direct telephone connection with the office by means of 120 circuits connecting with an annunciator containing 120 drops. Guests can communicate their wants directly to the office or can be placed in direct communciation with one another. A magneto transmitter is used in the office and microphone transmitters are used in the guests' rooms and departments. The small circular receiver is used throughout. Storage batteries charged from the lighting system of the building supply current to operate the microphone transmitter and also the annunciators.

Some weeks ago it was reported that the St. Louis street car manufacturing companies had consolidated. This report turns out to be erroneous. An attempt was made to effect a consolidation, but this, like a former effort some years ago, resulted in failure.

The Postal Telegraph-cable company is putting in a dynamo plant at Kansas City to take the place of 4,000 battery cells. The company has just finished the installation of a storage battery plant at Albuquerque, N. M.

R. J. H.

## PERSONAL.

Charles D. Shain of New York was in Chicago last week renewing old acquaintances.

I. H. Rogers, assistant general manager of the Bruh

Electric company, Cleveland, O., was in Chicago last week.

F. S. Hunting, chief engineer, and Charles C. Miller, advertising manager, of the Fort Wayne Electric corporation, were in Chicago last week.

## NEW INCORPORATIONS.

Salina Telephone company, Salina, Kas.; capital stock $10,000: R. H. Allerton, Kansas City, Mo.

Polar Star Electric company, Faribault, Minn.; capital stock, $50,000; J. Hunter, Faribault, Minn.

Mutual Gas & Electric company, Brooklyn, N. Y.; capital stock, $100,000; to supply gas and electricity.

Paragould Electric Light company, Paragould, Ark.; capital stock, $5,500; to furnish electric light; T. H. Wyse, Paragould, Ark.

Cook County Electric Railway, Light & Power company, Chicago, Ill.; capital stock, $500,000; Clarence N. Durand, Chicago, Ill.

Canton Mutual Telephone company, Canton, O.; capital stock, $10,000; to conduct a telephone exchange; S. D. McKelvey, Canton, O.

National Electrical Reminder company, Chicago, Ill.; capital stock, $250,000; to manufacture electrical devices and merchandise; Siegfried Rosenfield, Chicago, Ill.

Terre Haute & Brazil Electric Railway company, Terre Haute, Ind.; capital stock, $160,000; to construct and operate an electric railway; Max Joseph, Terre Haute, Ind.

Westlake Electrical Manufacturing company, East St. Louis, Ill.; capital stock, $100,000; to engage in the manufacture of electrical specialties; Chas. T. Westlake, East St. Louis, Ill.

## ELECTRIC LIGHTING.

J. S. Bowers proposes to organize an electric light company in Moberly, Mo.

Dunkirk, Ind., has granted an electric light franchise. The plant is to be in operation in ninety days.

Fargo, N. D., is growing rapidly, and the electric light plant has been increased by 200 horse power to meet the demand.

On Tuesday the citizens of Port Huron, Mich., voted on the question of issuing bonds to the extent of $40,000 for the purchase or construction of an electric lighting plant.

The Citizens' Electric company is endeavoring to secure a franchise to use the streets of Syracuse, N. Y. It is said that this company, if successful, will use Westinghouse apparatus.

The city of Lynchburg, Va., will erect a lighting plant having a capacity of 300 arc lamps of 2,000 candle power each and 2,000 incandescent lamps operated on alternating current circuits.

The Grand Island, Neb., Incandescent Light & Power company is rapidly completing its plant, and incandescent lights will illuminate the business houses of the city by November 15th.

The committee on lighting of the Cambridge, Mass., city council has been instructed to consider the advisability of doing away with all street gas lamps when the contract for gas lighting with the Cambridge Gas Light company expires on November 16th, with a view to the complete ultimate lighting of the streets by electricity.

Sealed proposals will be received by the trustees of the Dayton State Hospital, Dayton, O., until 10 A. M. of Thursday, November 22d, for furnishing and erecting an electric lighting plant at the hospital. Copies of the plans and specifications and blank proposals can be obtained at the office of the trustees, Dayton, O., or of the engineer at Ohio State University, Columbus, O.

## ELECTRIC RAILWAYS.

An electric line to connect Cleveland and Elyria, O., is to be built.

President Depew of the New York Central & Hudson River Railroad company is reported to have said that he expects the Vanderbilt roads will be carrying passengers between Albany and New York city in less than two hours before the close of the year 1895, and that the motive power will be electricity instead of steam.

The Allegheny, Pa., Traction company has found the fifteen cars first put on its Millvale, Etna and Sharpsburg branch insufficient to meet the wants of the public, and has contracted for ten additional cars to be in service within fifty days. The patronage given the road thus far has exceeded the expectations of the management, and guarantees the success of the new line.

The Business Men's Club of Carthage, Mo., has, through a committee, arranged to raise a subscription of $15,000 as a bonus toward building an electric line between Carthage and Webb City and Carterville, which is to be built by Chicago capitalists. The city has granted a franchise of liberal character as an inducement. The committee in charge has already secured over $11,000 of the sum.

A Baltimore dispatch says: The interest taken at Westminster and Reistertown, Md., and Littlestown and Gettysburg, Pa., in the proposed chain of electric roads to connect Baltimore with the famous battlefields assures the construction at an early day of the connecting links of the roads now in operation. The Elkins-Widener traction syndicate is backing up the enterprise, and it is said that there is also a plan under consideration for the construction of trolley lines from Philadelphia to Gettysburg. The distance from Baltimore to Gettysburg by the route laid out is 50 miles, as against 72 miles by steam railroad.

The new power house of the Syracuse, N. Y., Street Railroad company is to be erected on Tracy street. At the start 1,200 horse power capacity in engines and generators will be placed. The building and site will cost $40,000.

It is stated at Colorado Springs that a proposition has been made to the officials of the Denver & Rio Grande railroad to change the branch line to Manitou into an electric line. It is proposed to use the overhead trolley system. The electric plant could be located at Colorado City, and, in addition to supplying sufficient power for the running of cars, would supply the light for the depots in Colorado City and Manitou and the joint Rio Grande-Rock Island depot in Colorado Springs. It is estimated that the company could by this method double its present service and make a saving of over $1,500 per annum. The electric system would not necessitate any change in the trackage or roadbed, as the same rails would be used as are now laid.

## MISCELLANEOUS.

It is rumored that an electrical training school at Wilkinsburg, Pa., is to be established under the patronage of George Westinghouse, Jr.

Superintendent A. A. Forman of the Electric Light company of Iron Mountain, Mich., met with a very severe accident last week while opening a main line switch carrying 80 amperes of current at 1,000 volts. His hand temporarily closed the circuit for a sufficient time to burn all the skin and flesh from the greater part of his hand.

Prof. D. T. MacDougal, of the department of botany at the University of Minnesota, is making arrangements to experiment on the influence of electricity on growing plants. He is at present engaged in constructing the necessary apparatus. The plants upon which the experiment is to be tried are in the green-house upon the campus, and the experiments will be extended over a series of years. It is expected that valuable results will follow.

Commenting on the recent death of Miss Belle White in Chicago, while undergoing electrical "treatment" for the removal of freckles, the *Electrical Review* of London says: "It is a wonder that such deplorable results did not accrue on this side of the Atlantic before the crusade against electrical quackery was fought and won, for the treatment in some cases was conducted with the same want of experience of which our contemporary [the WESTERN ELECTRICIAN] complains."

A few days ago an interesting trip was made between Cleveland and Pittsburg on the Cleveland & Pittsburg railroad by a train carrying electrical machinery from the Brush works so that a portion of Pittsburg should not be in darkness on account of the destruction of part of the illuminating machinery. The train consisted of three freight cars and a freight engine. It started from Cleveland at 10:58 A. M. and arrived at the Pennsylvania street station in Pittsburg at 3:50 P. M., a distance of 150 miles, in four hours and fifty-two minutes, an average speed of thirty miles an hour.

## TRADE NEWS.

Lee & Collins announce that they have removed to 239 La Salle street, Grand Pacific Hotel, Chicago. This firm has added several new specialties to its list of late.

Westinghouse, Church, Kerr & Co. announces the removal of its New England office from 620 Atlantic avenue to the Exchange building, 53 State street, Boston.

The Alfred Moore company of Philadelphia is very busy at present filling orders for insulated wire. It reports a decided improvement of trade during the last month.

James Smith & Co. of Philadelphia have recently placed on the market a new packing. It is made in all shapes, and the firm reports a large sale to the central station and power companies.

J. Paul Gaylord, president of the Pennsylvania Engineering company of Philadelphia, has returned from an extensive business trip through Europe, which he reports proved entirely satisfactory.

The Washington Electric company, 207 South Canal street, Chicago, reports doing an excellent business during the month of October; an unusual demand seemed to exist for its well known rheostat and stage dimmer.

The Cutter Electrical & Manufacturing company of Philadelphia is working its factory to the full capacity in order to fill pressing orders for its double push switches. The company reports a larger business for October than any previous month during the last year.

The Electric Appliance company, Chicago, is hard at work upon its catalogue of electric railway supplies and hopes to have it ready for distribution in a few weeks. The company promises to list a very desirable line of electric railway material, including the "Lynn" specialties.

The new power station for the Nassau Electric Railway company at Brooklyn, N. Y., will be 102 feet wide and 150 feet long, and will be constructed entirely of iron and steel, the whole designed and built by the Berlin Iron Bridge company of East Berlin, Conn. The roof will be covered with the Berlin company's patent anti-condensation corrugated iron roof covering.

John F. Bahr, 55 Dey street, New York, is introducing an improved telephone receiver in which he claims to have combined simplicity, practicability and cheapness. These instruments are finished in hard rubber cases; the receivers work in perfect unison with transmitters of any make, and can also be used as transmitters by connecting two receivers together in the usual manner. They are perfectly reliable, too, it is claimed, on long or short lines.

The Crefeld Electrical Works, with main office at 620 Atlantic avenue, Boston, is the name of a new concern which will manufacture a full line of insulated wires and cables of all sizes. They have a large factory near Boston which has recently been equipped with improved machinery. The output of the concern will be handled by C. E. Bibber, C. A. White and H. H. Brooks as general sales agents, with office address at 620 Atlantic avenue, Boston. These gentlemen are widely known to the electrical trade as wide-awake "hustlers." They deserve success.

The United Electric Improvement company of Philadelphia has removed its office and works to the new factory building at Allegheny avenue and Nineteenth street. The location is convenient to Germantown Junction on the Pennsylvania railroad, to the Tioga station on the Philadelphia & Reading road, and can be reached by the Thirteenth street trolley line. This company manufactures alternating current generators, direct current machinery for lighting and power transmission and improved long-distance series incandescent apparatus. The enlarged facilities insure prompt delivery of goods.

The E. P. Gleason Manufacturing company of New York notes a decided revival of business during the last month, especially in the electrical trade. The company now runs its glass blowing department until nine o'clock every evening to keep up with pressing orders, while the metal work has increased a large per cent. of late. A very large demand is made for its porcelain cut-outs, which it claims is the smallest covered solid porcelain cut-out on the market. The Chicago office, in charge of F. L. Johnson at 91 Dearborn street, was opened after careful consideration, and from the orders received the company is satisfied it was a move is the right direction.

"Charlie" Gregory, cheerful, confident and irrepressible, declares that he knows nothing of such a condition as hard times at the establishment of the Chas. E. Gregory company, 47 and 49 South Jefferson street, Chicago, "the electrical bargain house," where electrical supplies and machinery "that have seen service" are bought and sold. The business shows a very substantial increase over last year, and the company is constantly in receipt of out-of-town orders from all parts of the country. As an electrical salesman Mr. Gregory stands in the very foremost rank, and it is to his keen business ability, care to avoid misrepresentation and personal popularity that the success of the business is due.

## BUSINESS.

Secretary and Manager R. Humffreys-Roberts and Rodolphus Fuller, electrican and mechanical engineer of the Fontaine Crossing & Electrical company, Detroit Mich., paid a flying visit to Chicago last week in the interest of their company.

The K. W. fuse receptacle with shade holder attachment, manufactured by the Bryant Electric company, is an excellent article for ceiling work. Grier Bros., the western representatives, carry these goods in stock in the Monadnock Building, Chicago.

The Helios Electric company of Philadelphia reports that it will be obliged to run its factory over-time to keep pace with the large number of orders for the new alternating arc lamp which it is making. This lamp furnishes 900 candle power, taking 7 amperes at 28 volts or 4½ amperes at 50 volts, 2¼ amperes at 100 volts. It consumes the energy of 3½ 16 candle-power incandescent lamps. A small alternating lamp is only possible with a reflector plate. One order for 125 of these lamps to be delivered to a western firm was received one day last week.

Word has been received from Col. S. G. Booker, superintendent of the Phoenix Carbon Manufacturing company of St. Louis, to the effect that his newly organized business is now running most successfully. The factory is worked to its full capacity, making everything in the carbon line, moulded and forced, also hollow and cored carbons suited to any system of American arc lighting. The Phoenix company is also making a speciality of battery elements, and is manufacturing a high class line of motor and generator brushes. Under the expert management of so experienced a man as Col. Booker there is no reason whatever why the Phoenix Carbon Manufacturing company should not immediately take its place in the front rank of that class of manufacturers. Mr. Booker has been in the carbon business for many years, and his extensive experience and wide personal acquaintance are sufficient to insure at the start a valuable trade.

J. Grant High & Co., who are among the best known manufacturers of switchboards and switches in the East, have had such an increase in business and inquiries in the West of late that they have experienced the necessity of a branch office in Chicago. They have established quarters at No. 807 Medinah Temple, which is located in the electrical section of the city, and are now in shape to furnish at once estimates on switchboards of any size, style or finish. They make a line of switches in which the great merit of an absolutely perfect contact is positive, and also an excellent quick-break switch for high pressure currents, the spring of which is most durable and not possible to heat up and lose its tension. This firm has built some of the finest boards in the East and has special machinery and tools and can turn out strictly first-class work. They make switches from 25 amperes capacity up, and keep in stock up to 1,000 amperes, both single, double and three-pole, either single or double throw.

The Mather Electric company of Manchester, Conn., reports that it has been obliged to run its works until ten o'clock every night for some time to fill its orders and that it has at present enough work on hand to keep it busy for three months. The company reports sales of five 500 volt, four 220 volt and four 120 volt generators, two Manchester exciters, seven dynamos with a capacity of 3,000 lights, four Manchester motors aggregating 31 horse power and one special 600 ampere dynamo. Following is a list of the

companies placing these orders: Hartford & West Hartford Street Railway company, Hartford, Conn.; Bloomington City Railway company, Bloomington, Ill.; Ancry Manufacturing company, Manchester, N. H.; Charles E. Lewis Clothing Manufacturing company, Belleville, Ill.; Stamford Hotel, Chicago, Ill.; John Jermyn, Scranton, Pa.; Southwest Virginia Improvement company, Pocahontas, Va.; Somers Fuel company, Belle Vernon, Ohio.; J. Holt Gates, Chicago, Ill.; Burtis & Howard, Minneapolis, Minn.; Stanley Electric company, Pittsfield, Mass.; Jones & Lamson Machine company, Springfield, Vt.; Warren Shaw & Co., South Peabody, Mass.; Lewis Anderson & Co., Scowhegan, Me.; George Pappert Manufacturing company, North Milwaukee, Wis.; H. B. Coho, New York; Cobb, Bates & Yexra, Fall River, Mass.; Chambers Electric Light & Power company, Truro, N. S. (sixth order); Ohio State University, Columbus, Ohio (second order); sheriff of Hampden county, Springfield, Mass.; Ætna Electric Works, Hartford, Conn.; Harry S. Anderson, Springfield, Mass. Among the shipments during the month of October were two directly connected machines, four 220 volt generators, twelve incandescent dynamos having a capacity of 3,900 lights, and nine Manchester motors aggregating 90 horse power.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued October 30, 1894.*

528,149. Trolley Catcher. W. D. Cobb, Fort Worth, Tex. Application filed May 29, 1894.

The trolley pole is dropped to a position of safety when the trolley wheel leaves the wire, and is prevented from coming in contact with the supports of the trolley wire, the feeders, etc.

528,184. Electric Arc Lamp. R. Segerdahl, Chicago, Ill. Application filed February 26, 1894.

The objects of the invention are, first, to provide means whereby the resistance may be attached to the lamp structure without disfiguring the general appearance of the lamp; second, to obviate accidents from fire, which are liable to occur when a resistance within an inclosure is used; third, to obtain a cheap and durable structure and which is readily attached to the lamp.

528,185. Automatic Electro-magnetic Cut-out. L. T. Stanley, Brooklyn, N. Y., and A. E. Broddell, Philadelphia, Pa. Application filed August 22, 1893.

In an automatic cut-out is claimed the combination with an insulating block of four plates secured to the edges of the same and forming respectively, or connected with the terminal plates of the switch and the binding posts of the line, a fuse box having terminal plates to which a fuse is connected, the said plates being adapted to engage with and bridge the plates on the sides of the block and to mechanically secure the fuse box thereto.

528,188. Electric Transformer. Elihu Thomson, Lynn, Mass. Application filed January 29, 1890.

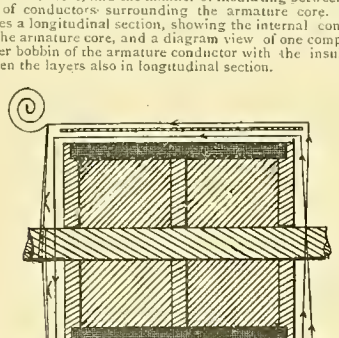
This invention consists essentially in a converter built up from L-shaped sheet iron pieces disposed to form the core or magnetic circuit of the apparatus, and assembled in such a manner as to have a solid central core piece passing axially through the electric coil.

528,189. Thermostat. D. W. Thompson, Chicago, Ill. Application filed November 9, 1889.

One of the claims made by the inventor is for a heat regulating apparatus, comprising a valve or damper, a motor for actuating the same, two thermostats, each of which embraces a compound strip or coil and two contact points, two conductors leading from the motor to the thermostats and connected by branch conductors with the opposite contact points of both thermostats, a switch provided with three contact points, a third conductor leading from the motor to the pivot of said switch, a battery in circuit with said third conductor, and separate conductors leading from the said compound strips or coils to two of the contact points of said switch, the third contact point of the switch being insulated, whereby either thermostat may be thrown in circuit with the battery as desired, or both may be thrown out of action by resting the switch on the insulated contact point.

528,204. Armature for Dynamo-electric Machines. Thomas H. Hicks, Detroit, Mich. Application filed July 14, 1893.

The improvement claimed is in the construction of the core of the armature, the system and manner of winding the conductors on the core, and the manner of insulating between the layers of conductors surrounding the armature core. The cut gives a longitudinal section, showing the internal construction of the armature core, and a diagram view of one complete two-layer bobbin of the armature conductor with the insulation between the layers also in longitudinal section.



NO. 528,204.

528,205. Conduit Electric Railway. Julius L. Horing, St. Louis, Mo. Application filed February 19, 1894.

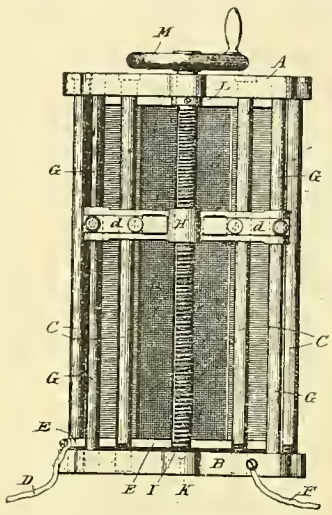
The principal object of the invention is to construct a conduit of suitable insulating material, so that when the main conductor is located therein there will be but a small portion of its surface exposed.

528,243. Rheostat. M. Waddell, Bridgeport, Conn. Application filed September 6, 1893.

In the cut *A* and *B* represent retaining end plates of the rheostat, and *C C* connecting bolts holding the end plates, and forming a suitable containing frame for the variable resistance. These connecting bolts pass through the plate *A* and are headed on this end, and screw-threaded at the other end to enter and engage tapped holes in the end plate *B*. A conducting wire *D* is connected to the plate *E*, which is insulated from the plate *B*. Another conducting wire *F* is connected to the plate *B* in electrical connection with guide rods *G*, upon which traverse the brush carriage *H*. Movement may be given to the brush carriage by any suitable means as by a screw *I* engaging therewith, stepped at *K* in the plate *B*, passing through the plate *A* and secured from longitudinal movement by a collar *L*. A hand wheel *M* serves to rotate the screw to move the brush carriage in either direction. Suitable conducting brushes *N N* on the carriage bear upon the variable resistance, which is arranged so as to present the edges of alternate strips of conducting and insulating material. This variable resistance consists of strips or sheets of conducting material of high specific resistance, such as sheet-iron built up into a substantially sinuous form with strips of insulation such as mica between the plates.

528,245. Electric Railway Signal. A. J. Wilson, Port Chester, N. Y. Application filed November 21, 1892.

In an electric signaling system for railways the combination is claimed of a series of track sections, each divided into a series of sub-sections, the inner sub-section of each section being also the outer sub-section of the succeeding section, overlapping signal circuits, one for each section, one side of which extends continuously along the track and the other side of which extends approximately from end to end of the section, a series of normally closed circuit-breakers in each signal circuit, a normally closed track circuit for each sub-section, including the rails thereof, and a magnet for operating the circuit breakers upon a change in the electric condition of said track circuit.



NO. 528,243.

528,246. Electric Railway Signal. A. J. Wilson, Port Chester, N. Y. Application filed December 16, 1892.

The invention permits blocks of considerable length to be employed, and this is accomplished notwithstanding poor insulation of the roadbed, and permits blocks of ordinary length to be employed where the condition of the roadbed would prevent efficient operation with the signaling devices and circuits heretofore employed.

528,268. Ohmmeter. A. H. Armen, Lynn, Mass. Application filed April 21, 1894.

The object of the invention is to measure the resistance of wire to electrical currents by a pointer and graduated arc similar to voltmeters. This is accomplished by the combined use of an index with an indicating mark, a Wheatstone's bridge, a rheostat and a coil with a magnetic needle and a pointer vibrating in the coil, and also with a magnet external to the coil. In the drawing *A* represents a cruciform coil of insulated wire wound on the spool *B*, mounted for use on a box *C*, and covered by a top casing. In the hollow center of this spool and coil a magnetic needle *e* with a pointer *E* is pivoted, its free end projecting so as to vibrate and traverse the graduated arc or index *F*. A magnet *N* is mounted with its poles turned down and in close proximity to the coil *A*.

528,286. Galvanic Battery. M. M. Clark, Chicago, Ill. Application filed May 27, 1893.

One form constructed in accordance with this invention comprises a cylindrical bag or sack of some textile fabric, a circular plate of earthenware closing the lower end of the sack and secured thereto, two semi-circular plates of earthenware closing the upper end of the sack and adapted to admit the negative electrode between them, and secured to the sack, and in connection with the negative electrode, means for retaining the electrode in position in the sack. This combination, for convenience, is designated the "negative element." In constructing this form the earthenware plates are secured in their places in the sack by means of some waterproof cement, but they may be secured by bands bound around the sack, compressing the latter into grooves formed in the peripheries of the plates. The negative electrode, which may be a carbon plate of the usual form, is retained in position in the sack by a pin projecting upon opposite sides of the plate, and resting against the under side of the earthenware plates which close the upper end of the sack.

528,291. Underground Conduit. James F. Cummings, Detroit, Mich. Application filed January 16, 1894.

This conduit is composed of sections formed of an outer casing inclosing as many wooden ducts as there are separate conductors, the wooden ducts being constructed moisture and air tight suitable for the reception of a naked conductor and insulated from each other and the outer tube by a dielectric surrounding and separating the ducts. The ends of the sections when connected form continuous outer and inner ducts in which the joints lap each other.

528,301. Art of Coating Electric Conductors. A. F. Montgomery, Lincoln, R. I. Application filed July 2, 1894.

It is proposed to more evenly and better fill the interstices of a fibrous or porous covering with a liquid, and to do it by a continuous process instead of by an intermittent process. The wire to be coated is passed through rarefied air and immediately thereafter into the coating fluid, the wire being passed into the rarefied air through a stuffing box and out of the coating fluid through a stuffing box. In this way the operation may be made continuous, and every part of the covered wire may be equally exposed to both this vacuum and the coating liquid.

528,330. Conduit System for Electric Railways. John B. Linn, Cleveland, O. Application filed December 9, 1893.

The combination with a slot rail formed in sections with intermediate boxes is described, each section consisting essentially of a grooved beam having therein an insulated conductor, and each box being grooved to form a continuation of the slot, of a connection from the conductor to contacting devices in the boxes, a laterally arranged shaft in each of the boxes, having a swinging arm adapted to engage with the contacting devices, a flexible shoe adapted to travel in the slot, and having a metallic bottom thereon, a projecting arm on each of the shafts arranged within the slot and adapted to contact with the bottom of the shoe, so as to operate the swinging arms, and thus establish an electrical connection from the conductor to the metallic portion of the shoe.

528,345. Telegraph Key. C. F. Sebring, Leeds, Mo. Application filed July 2, 1894.

The invention relates to telegraph keys, and more particularly to that class which automatically completes the circuit after being used. The object of the invention is to provide a self-closing attachment applicable to any of the ordinary telegraph-keys in general use, which is simple, durable and inexpensive, and which may be easily and quickly secured in position.

528,379. Closed Conduit Electric Railway. James F. McLaughlin, Philadelphia, Pa. Application filed May 10, 1894.

This invention has reference to improvements in closed conduit electric railways, and its object is to provide a construction in which exposed sections of a sectional working conductor are successively coupled with a supply conductor in the closed conduit, by the passage of a motor car along the railway, the circuit between the supply and working conductors being broken at all points on the road except where covered by the motor car.

528,430. Electro-magnetic Switch. J. G. Hartel, Keokuk, Ia. Application filed December 2, 1893.

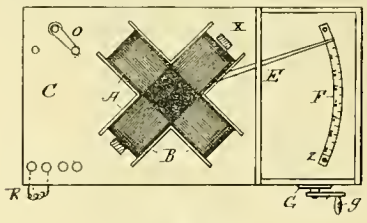
A switch held in a closed position by a spring actuated catch, a releasing mechanism connected with the catch, and an armature placed on the field magnet of the motor and connected with the releasing lever are the principal features of the invention.

528,440. Reversing Mechanism for Electric Motors. J. Mellen and N. O. Goldsmith, Cincinnati, O. Application filed March 24, 1894.

This reversing instrument for electric motors is so arranged that every time that the motor is connected in circuit with the main line the armature of the motor will revolve in one direction, and when the circuit is broken and the connection made the second time the armature of the motor will revolve in the reverse direction. This is accomplished by means of two wires from the place of control to the reverser; and it is especially adapted to reverse motors at a distance from the place of control by the use of two wires instead of four wires, and is also especially adapted to operate railway signals, railway switches and other mechanism requiring to be moved alternately in opposite directions.

528,444. Electric Signaling Apparatus for Block Systems. M. S. Reiley, Washington, D. C. Application filed June 13, 1894.

It is proposed to so organize a system of signals of this type that the presence of a train upon any block section, the breaking or displacement of a rail, an open switch, or other interruption of normal conditions, shall be indicated at the instant of occurrence by a suitable signal or signals.



NO. 528,260.

528,445. Secondary Battery. John E. Rhetts, Salem, Ind. Application filed November 22, 1893.

The object of the improvement is not only to avoid the "buckling" which takes place in these forms of cells, but also to construct an electrode without any soldered joints.

528,465. Electric Machine for Railway Systems. E. Deming, New York, N. Y. Application filed May 27, 1893.

A locomotive or train of cars on any given block may open an electric circuit, and at the same time close an electric circuit through a magnet which operates to close another circuit at a preceding or following block.

528,477. Supply System for Electric Railways. Charles H. Haskins, St. Louis, Mo. Application filed December 9, 1893.

The invention relates to that class of electric railways in which there are a series of switches arranged along the track that are adapted to be operated by a contact plate secured to and carried by the car, to close the circuit between the main conductor and the car motor at the time the car is passing, and to break the circuit as soon as the car has passed.

528,494. Closed Conduit for Electric Railways. W. E. Stearns, Berlin, Conn. Application filed April 7, 1894.

An electric railway system is described, in which the electric wire or conductor is entirely inclosed in an insulating envelope provided with means for intermittently making contact.

# Western Electrician.

EVERY SATURDAY.

Vol. XV. CHICAGO, NOVEMBER 17, 1894. No. 20.


## A Western Two-phase Plant.

The chief distinction of the small central station plant of the Twin City Gas & Electric Light company of La Salle, Ill., herewith illustrated, lies in the fact that it is one of the first in the West to make use of the new Stanley two-phase alternating current machinery. The Twin City company, of which James W. Duncan is president and Frank Bedard is superintendent, has two Ide engines, one driving two Thomson-Houston 30 light arc machines of the well-known spherical armature type, and the other operating a 60 kilowatt Stanley two-phase alternator. The illustration gives an exterior view of the station and two glimpses of the dynamo room, the latter showing the alternator from different points of view. The switchboard, which can be seen in

A WESTERN TWO-PHASE PLANT.

the right-hand picture, consists of a slab of marble supported by a substantial iron standard, and is equipped with the necessary station instruments.

The alternator supplies current for the old circuits of the company at 1,000 volts, but one of the peculiarities of the machine is that one side or phase may be run at 1,000 volts and the other at 2,000, and that the change from 1,000 to 2,000 volts can be made at any time by changing the connections on the terminal board of the machine, and these two circuits may be brought together anywhere and used for motor circuit, whether they are at the same voltage or not.

The interesting characteristics of the new Stanley apparatus were described at considerable length in the WESTERN ELECTRICIAN of June 16, 1894, but it may be stated that three months' practical operation at La Salle has demonstrated the advantage of the absence of commutator or collector rings, due to the fact that there is no revolving wire part in the machine, as during that time the only attendance needed at the dynamo was one changing of the lubricant for the self-oiling bearings.

The machine is symmetrical and substantial in design. Under ordinary conditions it is self-regulating, and, if necessary, the entire load may be thrown off without paying attention to the generator. This regulation is obtained without the loss involved in compensating or compounding. The machine is reported to show an efficiency at full load of 94 per cent. The required exciting current is small, being less than one kilowatt.

## Proposed Pacific Cable.

On Friday, November 9th, proposals for the construction and maintenance of the proposed Pacific cable were opened by the minister of trade and commerce at Ottawa. The advertisement which the Dominion Government issued asked for proposals for laying a cable by eight different routes. Six offers have been received, all of them by English manufacturers.

Mr. Bowell, minister of trade and customs, does not deem it advisable to make the figures public at present. It is learned, however, that the offers received in every case are below the estimates by Mr. Fleming; indeed, the proposals are in each case much more favorable than was anticipated by some of the gentlemen who discussed the project at the recent colonial conference, and, it is said, completely remove every obstacle urged against the feasibility of the Pacific cable. The six firms tendering are among the chief cable manufacturers and construction works in the world. Their proposals indicate a thorough examination of the great Pacific cable project. In the proposals submitted by those willing to establish the line no objection is offered to the length of the link from Vancouver to Fanning Island, a British possession and the point designated as a landing place for the cable in the event of a suitable one not being forthcoming in the Hawaiian group. The Vancouver-Fanning Island stretch would be 700 miles longer than the one suggested to Necker or Bird Island, but this fact evidently has no weight with the cable men.

Sandford Fleming and W. H. Mercer, who visited Hawaii for the British and Canadian Governments in connection with the Australian cable, have returned to Ottawa. Mr. Mercer speaks hopefully of the result of their mission to Hawaii, which was to make proposals to the government at Honolulu in regard to a landing place for the proposed Pacific cable. In putting the project before the Hawaiian government they made a suggestion that one of the small islands be leased as a landing stage for the cable, and a subsidy of $35,000 for fifteen years be paid to Hawaii. No exclusive rights were asked. In return the cables rates from Honolulu would be one shilling a word for ordinary messages, nine pence for government messages and sixpence for press messages.

Mr. Fleming said: "We have established friendly relations with the Hawaiian government, and I am very hopeful that good results will come of it."

## English Electrical Water Power Project.

The work of utilizing by electrical transmission a portion of the power of Niagara Falls has directed attention to the possibility of making similar installations in other parts of the world. In Great Britain, for example, it is proposed to make use of a portion of the power of the far-famed Lake Windermere in the generation of electrical power, and a company has been formed for this purpose. A Scotch contemporary gives these particulars:

The prospects of the scheme are fairly encouraging, which will be seen when we state that the company has secured the right to utilize the fall of water from the southern end of Lake Windermere, which is the best piece of water power in England, being equal to 40,000 indicated horse power, and here works will be constructed for converting this into electricity of high potentiality, so that the current may be distributed over a wide area. The actual area over which it is proposed to distribute current from the works extends to about ten miles, and includes the towns of Ulleswater and Kendal, and several smaller places in the vicinity. The company has, we understand, decided to promote a bill in the next session of Parliament to enable it to proceed with the work. In the event of the experiment proving a success, similar works will, in all probability, be inaugurated in other parts of the kingdom, as well as in other countries where no such kind of enterprise has yet been thought of.

## The Knapp Failure.

On Monday about 80 signatures had been received by the Knapp Creditors' association to the petition asking the court to set aside the appointment of Receiver H. P. Lucas. Nearly an equal number of creditors have, it is said, signed a counter-petition asking that the present receiver be allowed to remain undisturbed. On the part of the Creditors' association, however, it is stated that some of those signing the pro-Lucas petition have since notified the creditors' committee that they desired to record themselves as favoring the opposition as to the existing receivership.

## Electrical Fires.

There is no dodging the fact that, by current escaping from conductors and by other means, electricity has, directly or indirectly, caused a considerable number of fires since its wide introduction into American commercial buildings and residences for lighting or power. These fires have been neither so numerous nor so serious as the opponents of electrical development have claimed and as many insurance men have believed; and it is also a perfectly fair assumption that the introduction of electric lighting, by largely replacing the far more dangerous gas, has really decreased the number of fires due to illuminating agents. Nevertheless, as fire due solely to the presence of electrical conductors may almost always be ascribed to inferior or improper construction, to which the best sentiment of the electrical fraternity is entirely opposed, nothing but good can come from the selection of a few examples of burnouts to serve as warnings to the electrical construction and supply man—or, rather, to owners and consumers who are well aware that the prices insisted upon are not sufficient to insure good work.

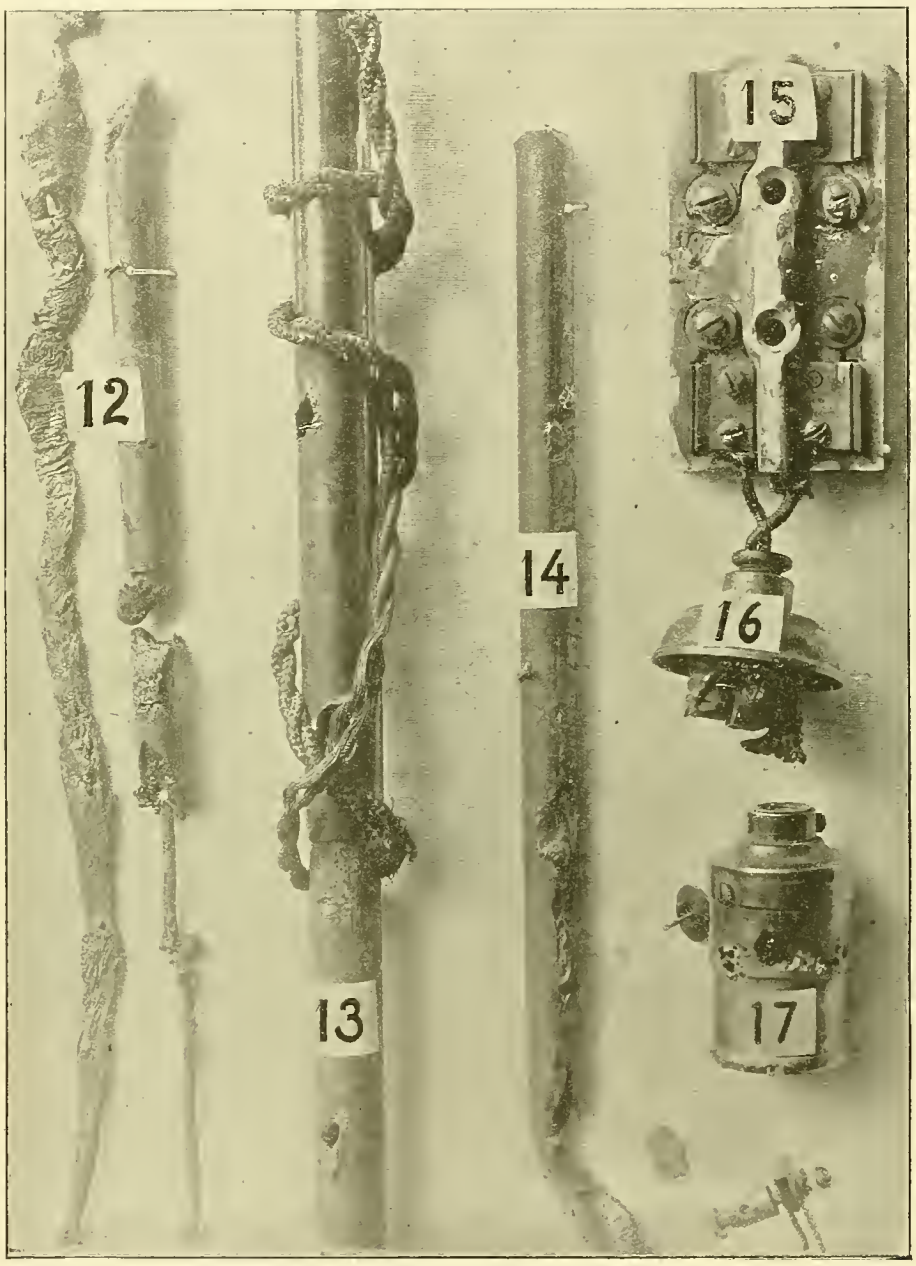



FIG. 1. ELECTRICAL FIRES.

The specimens shown in the accompanying illustrations were photographed for William H. Merrill, Jr., electrician of the Chicago Underwriters' association, and were collected by W. E. J. Deming, inspector of electric wires, Minneapolis, Minn. Mr. Merrill is the expert of the committee on fires of the Underwriters' International Electric association, for which he gathers statistics of fires said to have been caused by electricity. The specimens are labeled as follows:

Fig. 1—12. Melted wires; Edison street service tube; short-circuit from water. 13. Two 110 volt lamps in series on 220 volt circuit; short-circuit on gas fixture; 50 ampere fuse. 14. Street railway feeder carrying 500 volts grounded on gas pipe. 15. Fuse block used on 500 volt circuit; short-circuit from blowing fuse; fuse too short and opposite poles too close. 16. Edison socket melted by current short-circuited from water. 17. 1,000 volt current on 50 volt wires; fixture grounded and wires in contact with socket.

Fig. 2—18. Wooden base switch and wooden base cutouts burned from blowing of fuses and from poor contact in binding posts. 19. Samples of poor joints and some extraordinary fuses; woodwork ignited from these burnouts.

All of the specimens illustrated were taken from building equipments, but they are presented by the underwriters as "characteristic burnouts" and not as having caused any fire loss. Mr. Merrill does, however, in a recent report to the Underwriters' International Electric association, present a long enumeration of fires caused by electricity or supposed to have been caused by electricity. Almost all are unimportant so far as actual damage is concerned, the usual statement being "No loss" or "Loss small." Fires are mentioned, too, where there is no electrical fault, as the following: "Defective sprinkler head opened over 50 light arc dynamo and burned out armature. No loss." Here it is the sprinkler, and not the dynamo, that is in fault, yet the fire is classed as "electrical." In another case it is reported that a "window trimmer drove a nail through a flexible cord in a showcase; caused a short-circuit and small burnout." The window trimmer's carelessness, of course, caused the fire.

Some interesting cases, in which the electrical apparatus is more or less to blame, are as follows:

Cross between a guy wire and a trolley wire. A new building being constructed, an iron guy from the derrick was in contact with the metal on the roof of this building; a soil pipe passed up through the building (enclosed in a wooden box) and up through the roof, making connection with this metal. A lead water pipe ran parallel with this soil pipe in the same box, touching it in three places. It was found necessary to place another guy on the derrick, and it was carried across to the street. While placing it in position it was allowed to sag and came in contact with the trolley wire. Current was conducted into the building by the guy wire, the metal roof and the soil pipe and grounded on a water pipe, burning a hole through it about 10 inches long and also burning two holes in the soil pipe. No other damage than flooding building with water.

Switch used in connection with an automatic starting box for an electric motor stopped half way, leaving part of the resistance coils in circuit. The coils overheated and set fire to wood back of and in front of box. Slight damage to building and contents.

Sparks from trolley car ignited corn husks in street. One and one-half tons corn husks burned. No insurance.

An arc light wire chafed against an iron chimney. The insulation was worn off and the current followed down the chimney and onto two guy wires, one of which was attached to the frame bell tower of a fire department headquarters. Arcing occurred in the tower and ignited the woodwork. The chief of the fire department was knocked down and nearly lost his life by placing his hand on the base of the metal chimney while standing on the metal roof. The accident occurred during a heavy wind and rain storm. The fire loss to the tower owing to prompt discovery was small.

Cross between a trolley line and an 104 wire telephone cable at a junction of tracks. A trolley car took the wrong track and was pushed back without pulling down the trolley. The trolley caught in a frog and lifted the line until it came in contact with telephone cable extended over it. The lead covering of the cable was burned through and the current followed the telephone wires into exchange. Protective devices operated and prevented damage to switchboard. The only loss was to the cable.

A lamp in a private residence would burn at times and not at others. It was found that a nail in the floor board had broken the wire and would make or break the connection according as there was something pressing the board down or not.

Edison three-wire system entered area under sidewalk through street service to main cutout and then passed through area and building wall to center of distribution. The wires in the area were fastened to porcelain knobs and these were screwed to a pine board nailed to a brick arch. Water had soaked through the arch, completely saturating the board and the rubber covered wires. One of the porcelain knobs was found apparently twice its natural size through an accumulation of a white substance like salts. This knob was found to be extremely warm. The inspector bared the opposite outside wire and touching it with a wet board obtained a heavy arc, and with the distance between the two reduced to three inches obtained a blaze two inches long and heated the porcelain knob to a red heat. Wires strung under areas in this district are now supported on large size glass insulators.

Arcs between wires and gas pipes. In this risk there was one grounded motor circuit and a Heisler incandescent lighting circuit. After the wires had been installed the gas men ran pipes throughout the building so as to come in contact with the electric wires in a number of places. The fire occurred at the time of an electric storm and there was evidence that the lightning jumped from the wires to the pipes, causing an arc which set fire to the ceiling. Fires broke out in two places where the pipes crossed the wires. In one case the trouble being established on the motor circuit and in the other case on the Heisler incandescent lighting circuit. Loss not stated.

As will have been seen, the electrical fire inspectors discover many curious things. The interests of the insurance men and the electrical industries are not antagonistic and with a reasonable moderation on both sides, in discussing this subject, it may be expected that intelligent co-operation will considerably reduce the electrical fire hazard of the future. But it must not be assumed that every fire in a building containing electrical wires is due to electricity. It seems to be popular with newspaper reporters to ascribe the origin of mysterious fires to electrical causes, and the much-abused wires and switches are accused unjustly. Mr. Merrill cannot but be aware of this tendency, as in his report he says: "Several large fires occurred due to lightning discharges in which wires played no part. Reports are received of several large losses popularly supposed to be due to electricity, but in which any direct evidence is lacking. One large loss reported in several newspapers as due to electricity is stated not to be due to that cause. Accounts are received of the burning of several electrical generating stations from various causes other than electricity."

While considering the general subject of electrical fires it will be interesting to reproduce the cautions issued by the Underwriters' Electrical Bureau in relation to motors and arc lamps. These are as follows:

### THE ELECTRIC ARC LAMP.

An arc light is a fire which gives off sparks and small embers. It should be treated as such.

(a) The lamp should be carefully isolated from inflammable material. Ribbons, laces, paper and similar goods should not be draped about it.

(b) It should be provided with a glass globe surrounding the arc if any combustible material is under or about it.

(c) This globe should be securely fastened upon a closed base. If the globe is not securely fastened it will drop off. If it is open at the bottom the large sparks will fall through the opening.

(d) No broken or cracked globes should be used.

Sparks from arc lamps have caused damage to stocks of clothing, dry goods, millinery, carpets, paper, upholstered furniture and the like. Lamps having such goods under or near them besides having precautions (a), (b), (c) and (d) observed should also have:

(e) The principal orifice, that is, the top of the globe, closed so that it will be impossible for any sparks thrown

off by the carbons to escape. This can be accomplished by a "spark arrester," or by designing the lamp so that the globe will fit into the top part of the lamp, or by enclosing the arc itself in a closed glass tube placed inside the globe. "Spark arresters" are generally made of fine wire mesh and cost, when purchased from an electrical supply house, from seventy-five cents to three dollars apiece. Wire workers have been known to make good ones cheaper than this. Whether or not a spark arrester is effectual can be judged by adjusting it to a burning lamp and observing whether or not sparks penetrate it. Notice should also be taken of whether or not it is substantial and likely to last any length of time. If the lamp is so designed that the globe fits into the top parts of the lamp, wire spark arresters are, of course, unnecessary. This design will only be found, however, in some of the newer makes of lamps. Another arrangement which does away with the wire or metal arrester is referred to in the foregoing as a glass tube enclosing the arc. This device effectually encloses the arc so as to prevent the escape of sparks in any direction. Unfortunately it is a patented article. It is known as the Howard arrester.

(f) All lamp globes exposed to sparks should be provided with a wire netting. This netting should be made of fine wire and not have a mesh greater than 1¼ inches. It should be firmly secured to the globe so as to exert a little pressure. It will then hold the globe together in case it cracks or breaks, and will keep pieces from falling out of the lower portion of the globe if chipped out by the hot sparks. These nettings will not obstruct the light. They are sold by leading supply houses for 15 cents apiece.

(g) Plain carbons are preferable to copper coated carbons from a fire point of view for use in all arc lamps.

Tubes extending below the lower portion of the lamp globes should be closed at the bottom. Otherwise the carbons inside of them will drop out in case the clamps which hold them become loose. That is, all arc lamps should be provided with:

(h) Reliable "stops" to prevent the carbons falling out in case the clamps become loose.

### THE ELECTRIC MOTOR.

An electric motor is an engine used for furnishing power. Its controlling devices should be as carefully made and as carefully installed, and receive as careful attention, as those of any other kind of engine doing an equal amount of work.

*The Resistance Box or Rheostat* is the principal fire hazard in an electric motor equipment. It is used in starting the motor and sometimes to regulate its speed. It is a sort of throttle for the current. As its name implies, it contains a resistance to the flow of the current, generally coils of wire. A resistance introduced in an electric circuit transforms electrical energy into heat. Electric heaters are constructed on this principle. Therefore a resistance box, or rheostat, or regulator, is a source of heat. If current is left on one long enough it makes a first-rate stove.

The resistance box must be:

(a) Enclosed in a non-combustible case, such as iron or iron and slate. A wooden case is hazardous.

(b) Separated from combustible material, especially from the wall or board or partition upon which it is mounted. The iron or slate back of the case should be mounted away from the wall on porcelain knobs, so as to give it an inch or more air space, and the wall back of it protected with asbestos or sheet metal.

*The Switch* is the device used to open and close the circuit.

(a) It should be double pole; that is, it should open both sides of the circuit. Whether a switch is double or single pole can be determined by observing whether or not it makes a break in two wires or only one. If two wires run into and two out of a motor switch it is probably a double pole switch. All motors using resistance boxes should be provided with a double pole switch independent of the resistance box. No arrangement of a resistance box can satisfactorily do away with the necessity of using an independent double pole switch. If the switch is not double pole it will not open both sides of the circuit, and therefore the wires running to and through the motor and resistance box will not be effectually "dead" when the switch is open.

(b) It should be located within sight of the motor, otherwise an accident to the motor in starting it will not be quickly discovered. It is not usual to start steam engines in a basement by turning valves located on a roof. An electric motor is more liable to cause fire at starting than a steam engine, and its controlling apparatus should be so located that any accident to its working parts will be quickly discovered by the operator. The assured, for his own protection, should see the necessity of not having a preventable accident happen to his motor from this circumstance, because most policy forms do not cover losses to electrical machinery due to accidents in their working parts. Several cases are on record where motors have been injured by moisture or otherwise while not running, and upon being started up burned out and caused considerable damage.

(c) The switch should be mounted upon a non-combustible insulating base, such as slate, marble or porcelain. Wood is not proper to use for switch bases, nor for mounting any other device having uninsulated current-carrying strips, bars, posts or connections. Most of the fires caused by wood base switches have been due to arcing in a loose contact of the switch, setting fire to the wood. Several have been caused by moisture establishing a ground connection through the wooden base.

(d) The switch should have sufficient carrying capacity to prevent heating.

(e) If a knife blade switch is used, it should be so placed that gravity will tend to open it. Otherwise it may jar closed, and when the bearings work loose it will have to be held open by a block of wood or a string. From some unexplained cause the majority of knife switches throughout the country have been and still are installed wrong end up; that is, so gravity will tend to close them. It is a simple matter to reverse them. Placed right end up, the friction between the clips and the blades is sufficient to prevent them jarring open. The disadvantages of having a switch accidentally close are apparent.

Snap switches can be put up in any position, but they are not superior to knife switches for general use.

*The Cutout* is the device intended to protect the motor and its connections against harm from an excess of current. It contains soft fusible metal strips introduced in the circuit which are supposed to melt and open the circuit when the current flows in quantity sufficient to harm the motor.

(a) It should be double pole; that is, it should protect both sides of the circuit. Whether or not a cutout is double pole can be determined as directed in paragraph (a) of *The Switch*.

(b) It should be mounted on a non-combustible insulating base, such as slate, marble or porcelain. Wood is not proper to use for cutout bases. The blowing of the fuse may ignite the wood, and, as stated under paragraph (b) of

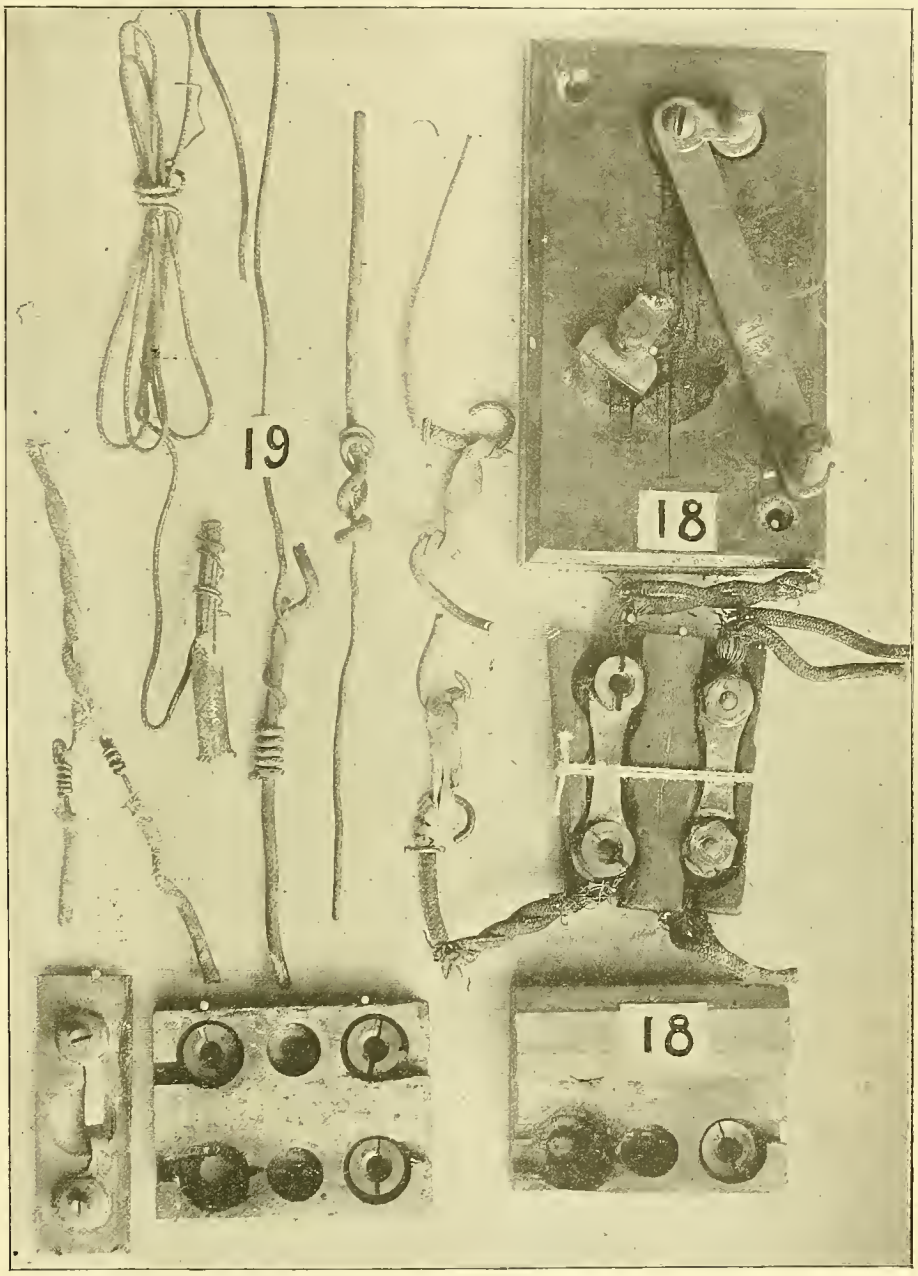



FIG. 2. ELECTRICAL FIRES.

*The Switch*, wood is not proper for mounting any uninsulated current-carrying strip, bar, post or connection.

(c) The fuse strips should have tips of harder metal soldered to the fusible portion so that a secure contact can be made under the screw connection without injuring the fusible metal. Fuse links having copper tips are moreover more correctly proportioned than fuse wire, and far more reliable. Fuse wire can be wound two or three times about cutout terminals so as to practically destroy its efficiency as a protective device. Similarly, nails, spikes and pieces of barbed wire fence cannot be considered reliable substitutes for fuse links. When "trouble" on a circuit causes fuses to "blow" better results will be obtained by finding and removing the trouble than by increasing the carrying capacity of the cutouts so that they will not melt until after the wire and apparatus they are designed to protect are burned up. A blackened, burned or smoked cutout base is a sign of a poor equipment or a careless operator. A cutout containing nails, wire, pieces of iron or anything other than properly proportioned and designed fuse links is a sign of criminal negligence. The fuse strips in the Edison "plug" cutout have tips of harder metal as required. For 500 volt circuits special cutouts should be used having metals at least 4½ inches long. The "plug" form and all other forms intended for use on 55, 110 or 220 volt circuits are not proper for use on 500 volt circuits because the current will hold an arc across the terminals after the metal has melted.

(d) The cutout should be isolated from inflammable material, or else it will start a fire when it melts and sparks. Where combustible dust or flyings are present the cutout should be enclosed in a fire-proof box. Fires have been caused by incandescent fuse metal from cutouts igniting dust, shavings, hemp, flour dust and similar materials.

*The Motor* should be raised at least eight inches above the surrounding floor so as to prevent water damage to the machine in case of a fire in the premises, and should be provided with a water-proof cover for use when not operating, for similar reasons. A water damage to an electric motor generally results in a claim for 70, 80 or 90 per cent. loss on the machine. Raising the motor above the floor on filled dry wood will also insulate it. Drip pans should be provided to prevent the oil from the machine saturating the surrounding floor, and the machine should be kept clean. Where dust or flyings of combustible material are present, the motor should be enclosed in a room or case.

Instructions in relation to dynamos, wiring, converters, etc., will doubtless soon be issued by this indefatigable organization.

## American Institute of Electrical Engineers.

Among the papers prepared for the meeting of the Society of Naval Architects and Marine Engineers at New York, November 15th and 16th, was one by S. Dana Greene on "Electricity on Shipboard—Its Present Position and Future Development." In view of the great interest among the electrical fraternity on this subject and the exceptional ability of the author to discuss it, an invitation was extended to the members of the American Institute of Electrical Engineers to attend the meeting and participate in the discussion.

## Brake Shoes.

Among the special papers presented at the Atlanta meeting of the American Street Railway association was one by D. F. Henry and Powell Evans on "Brake Shoes." This paper was a compilation of statistics, which the authors had gathered from various sources, including the results of tests and experiments conducted by manufacturers and users and the result of several years' experience in actual practice. Following is a summary of the report:

The necessity for effecting standards was the prime cause of existence of the Master Car Builders' association, which includes representatives from about every steam railway company in the United States. This association has collected most facts relating to the operation of all lines, and gradually reduced the greater number of details to standards. Among other net results at the present time are the standard track gauge, coupler, wheel and all such parts as must necessarily be similar to permit cars from any one line to be operated on any other.

If standards have proven simpler and more economical in every way for steam roads, the fact should apply with equal force to street railway operation. Up to 1886, when electricity began its revolution of the latter industry, the horse railways were often conducted in a rather careless manner, without due regard for petty economies. Until the last year or two, since the introduction of electric motive power, the enormous change and growth of the business has taxed its managers to the uttermost to care for the vital necessities for keeping their respective roads in operation. Now, however, when the power station, track, overhead line, car and motors are quite as perfect as similar parts of the steam railway, it is full time that this association should proceed to the adoption of standards for details.

I believe in standards throughout, but now wish to call your special attention to the subject of the "shape" and "material" for brake shoes. Brakes are applied to the track as well as the wheel, but as the latter practice, with few exceptions, is the rule, what follows has special reference to it.

The steam railways have reduced the parts of their brake-gear to a standard of shape—the beam, link, release spring, hanger, clevis and shoe. They have found designs good enough for all to use, and so good that no one road seems able to improve upon them.

Having decided upon these standards, they specify them when buying rolling stock, get them, and use them. Why should not our various truck manufacturing companies use a standard brake attachment; and if they can, why do we not decide upon one, and insist upon its use? As was stated above, the steam railways some time ago settled the matter of "shapes," so this point does not appear in their recent discussions on brake shoes.

The most reliable results obtained experimentally by the use of different shoes on chilled wheels and with different brake arrangements at the present time in hand, are those obtained by the Pennsylvania Railroad company (which furnishes the information) in various tests conducted during the past two years, which tests had different objects in view, as follows: First, a comparson of retarding power with one brake shoe per wheel and with two shoes per wheel with the same aggregate pressure applied to the wheel in each case; second, a comparison of retarding power with long and short shoes with one brake shoe per wheel in each case; third, a comparison of retarding power with uniform pressures by the use of cast iron, composite and three different grades of cast-steel shoes; fourth, a comparison of the durability of these cast-iron, composite and steel shoes in continued service; also, incidentally, the relative wear of the wheels under these different shoes.

Considering these in the order mentioned:

*First.*—Figs. 1 and 2 show the brake rigging on one four-wheel truck in these tests, Fig. 2 showing the ordinary method used with one brake shoe per wheel, and Fig. 1 showing two brake shoes per wheel, which is standard on the car used for these tests.

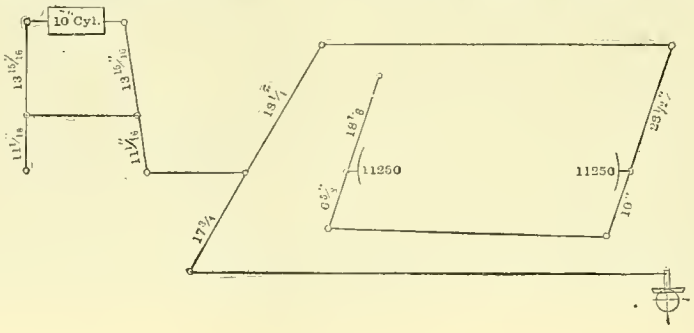



FIG. 2. BRAKE SHOES.

The tests were made on a uniform grade of about 80 feet per mile, with three cars, two of which were passengers cars and the other a dynamometer car placed between the two. The three cars together weighed about 130,000 pounds. The run was made by gravity and the start by releasing the hand brakes on the forward passenger car and on which alone the air brake was used to stop the three cars by opening the conductor's valve. The train of three cars was allowed to run a distance of one mile by gravity with the brakes released, and the time was taken by stop watches at the start and the end of one mile to check the uniformity of the speed attained in the different tests. On passing the one-mile post the air brakes were applied, as already explained, to the forward car only, with the other two cars pushing, and the time and distance required to make the stop were taken and the speed was recorded by the dynamometer car. The sliding of the wheels was noted by an observer at each end of the car which was braked. The condition of the rails was dry during the trials, but the wind, which was light, was in different directions and of different velocities on different days.

The sliding of the wheels was somewhat more with two shoes per wheel, but it was mostly on the last pair of wheels. It will be noted that there is practically the same efficiency in these two methods of braking.

*Second.*—The experiments as between long and short shoes were made in the same manner as described above, and the shoes of different lengths show about the same results.

In the two sets of tests it was noticed that the riding of the cars during the stop was much better with two brake shoes per wheel than with one brake shoe per wheel, due apparently to the fact that the application of the second brake beam to each pair of wheels partly counteracted the tilting of the trucks caused by the outside suspended beams when only one pair of shoes is used per wheel in this manner.

*Third.*—The experiments on retarding power with uniform pressures by the use of cast-iron, steel and composite shoes with one brake shoe per wheel were made in the same manner as already described, for the first tests.

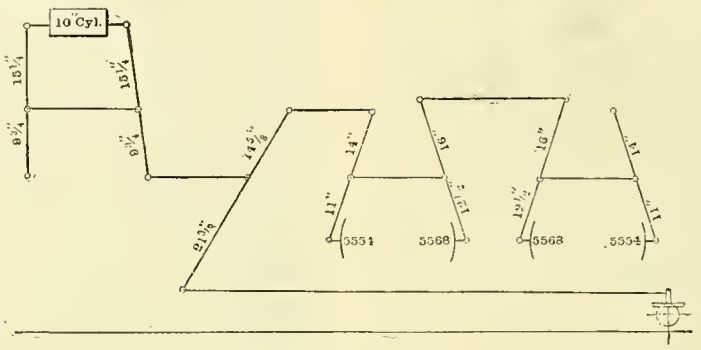



FIG. 1. BRAKE SHOES.

The composite shoes consisted of cast-iron with a small

BRAKE RESISTANCES.

| No. of Run. | Cast Iron Shoes. Pounds of Resistance. | No. of Run. | Composite Shoes. Pounds of Resistance. | No. of Run. | Steel Shoes "Z." Pounds of Resistance. | No. of Run | Steel Shoes "M." Pounds of Resistance. | No. of Run. | Steel Shoes "D." Pounds of Resistance. |
|---|---|---|---|---|---|---|---|---|---|
| 121 | 2,308.40 | 71 | 2,212.80 | 99 | 1,698 00 | 18 | 2,059.60 | 150 | 1,946.80 |
| 122 | 2,334.80 | 73 | 2,236.60 | 96 | 1,721.20 | 15 | 2,059.60 | 156 | 1,977 60 |
| 124 | 2,403 20 | 75 | 2,307 60 | 100 | 1,738.40 | 17 | 2,079.60 | 155 | 2,008.00 |
| 123 | 2,412.80 | 74 | 2,310.00 | 97 | 1,743.60 | 16 | 2,108.80 | 149 | 2,012.80 |
| 128 | 2,454 40 | 185 | 2,322.40 | 48 | 1,767.60 | .... | ..... | 158 | 2,020.00 |
| 127 | 2,462.40 | 187 | 2,349.60 | 50 | 1,810.40 | .... | ..... | 35 | 2,045 20 |
| 8 | 2,470.80 | 189 | 2,350.40 | 51 | 1,836.40 | ... | ..... | 159 | 2,092.80 |
| 125 | 2,479.60 | 184 | 2,362.80 | 95 | 1,867.20 | .... | ..... | 34 | 2,095.20 |
| 126 | 2,489 60 | 183 | 2,364.00 | .... | ..... | .... | ..... | 30 | 2,135.60 |
| 9 | 2,577.60 | 193 | 2,370.40 | .... | ..... | .... | ..... | 29 | 2,159.60 |
| ... | ..... | 191 | 2,372.80 | .. | ..... | .... | ..... | .... | ..... |
| ... | ..... | 186 | 2,405.20 | .... | ..... | .... | ..... | .... | ..... |
| ... | ..... | 192 | 2,410.40 | .... | ..... | .. | ..... | .... | ..... |
| ... | ..... | 182 | 2,414.40 | .... | ..... | .. | ..... | .... | ..... |
| ... | ..... | 190 | 2,449.20 | .... | ..... | .... | ..... | .. | ..... |
| ... | ..... | 183 | 2,453.20 | .... | ..... | .... | ..... | .... | ..... |
| | Av'r'ge. 2,439.36 | | Av'r'ge. 2,355.70 | | Av'r'ge. 1,772.85 | | Av'r'ge. 2,076.90 | | Av'r'ge. 2,049.36 |
| | Per cent 100 | | Per cent 96.58 | | Per cent 72.68 | | Per cent 85 15 | | Per cent 84.02 |

The car on which the tests were made required sixteen shoes, which were made up as follows in the first test: Four cast-iron shoes, four composite shoes, four steel shoes "Z," two steel shoes "D," two steel shoes "M." Grouping the two grades of steel "M" and "D" together as from one foundry, the total wear of the four shoes of each manufacture was as follows while the car ran:

| KIND OF SHOES. | WEAR. Actual Pounds. | Percentage Comp'rs'n. |
|---|---|---|
| 4 Cast Iron..... | 23.530 | 100 |
| 4 Composite..... ..... | 11.394 | 48 4 |
| 4 "Z" Steel..... | 2.337 | 9 9 |
| 2 "D" " ..... . } 2 "M" " . ... ..... } | 1.680 | 7 1 |

A second test was made to determine the durability of the shoes, and, if possible, to get a better record as to the relative wear of the wheels, and the following table gives the results, including also a statement of the relative distances run after the application of the brakes, taken from the former tests reported.

COMPARISON OF FOUR RUNS UNDER THE SAME CONDITIONS.

DISTANCE RUN AFTER BRAKING.

| No. of Run. | Cast Iron Shoe. Feet Run. | No. of Run. | Composite Shoe. Feet Run. | No. of Run. | Steel Shoe "Z." Feet Run. | No. of Run. | Steel Shoe "M." Feet Run. | No. of Run. | Steel Shoe "D." Feet Run. |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 1,806 | 192 | 1,887 | 49 | 3,087 | 15 | 2,471 | 157 | 2,162 |
| 7 | 1,893 | 184 | 1,927 | 50 | 3,904 | 17 | 2,575 | 150 | 2,866 |
| 5 | 1,805 | 68 | 1,941 | 51 | 3 829 | 16 | 2,708 | 29 | 2,307 |
| 6 | 1,834 | 65 | 1,865 | 101 | 3.425 | 18 | 2,720 | 34 | 2,594 |
| | Average 1,834 | | Average 1,905 | | Average 3,561 | | Average 2,618 | | Av'ge 2,482 |
| | Per Ct. Average 100 00 | | Per Ct. Average 103 87 | | Per Ct. Average 194.16 | | Per Ct. Average 142.69 | | Per Ct. Av'ge 135.33 |

Three sets of cast-iron shoes were practically worn out during these tests and one set of composite shoes, while the steel shoes were not much worn. So far as the wear of the wheels is concerned, the results were somewhat contradictory, and inasmuch as a large portion of the wear of the wheels is from the rail, it would be unsafe to ascribe all the difference to the shoes.

COMPARATIVE WEAR OF CAST-IRON, COMPOSITE AND STEEL BRAKE SHOES.

| KIND OF SHOE. | WEAR OF SHOES. Pounds. | Per Cent. | WEAR OF WHEELS. Reduction in Circumference in Inches. | Per Cent. | Relative Distance Run After Application of Brakes, Taken from Other Tests. | REMARKS. |
|---|---|---|---|---|---|---|
| Cast Iron.. ..... | 94 690 | 100.00 | 2.812 | 100.00 | 100.00 | 12 Shoes worn out. |
| Composite..... | 37.635 | 39.75 | 2.343 | 83 32 | 103.87 | 4 Shoes worn out. |
| Steel "D"..... | 5.708 | 12.06 | 1.156 | 82.21 | 135.33 | 2 Shoes slightly worn. |
| Steel "M and D" | 10.220 | 10.79 | 2.437 | 86.66 | 139.04 | 4 Shoes slightly worn. |
| Steel "M"..... | 4 532 | 9.57 | 1.281 | 91.11 | 142.69 | 2 Shoes slightly worn. |
| Steel "Z"..... | 8.194 | 8.65 | 2 969 | 105.58 | 194.16 | 4 Shoes slightly worn. |

The accompanying table on brake resistances presents selected runs for the purpose of making comparisons between runs in which the pressure in the brake cylinder varies between close limits of 39 5-8 minimum and 42 pounds per square inch maximum. In this table the figures have all been reduced on theoretical basis to 40 pounds pressure to the square inch, thus giving a number of cases which can be very accurately compared with one another. At the bottom of the table the averages are given with each kind of shoe and the percentages for comparisons:

Another table presents a comparison of the actual distances for four tests with each kind of shoe in which the air pressure and the speeds were almost exactly alike. It also includes a percentage comparison of the average of the four runs with each kind of shoe:

Two tests were made to compare the durability of the cast iron, composite and the three different grades of steel shoes in continued service, and incidentally the wear of the wheels was also noted.

In round numbers there are on all lines of street railways in the United States 50,000 cars, including steam and eletric motors, cable grip cars, trail and horse cars. These should not properly be lumped, as they include varying factors of weight and speed, varying the brake services required—but for the result in view, using low averages, this lump figure will be sufficiently accurate.

Assuming an average mileage of 75 miles per day for all cars, including an allowance made for cars used in rush hours only, and others under repair, the total result would be 3,750,000 car miles per day. Taking the average life of brake shoes at 5,000 car miles, and an average of 5 shoes per car, there is a daily consumption of 3,750 brake shoes, and an annual consumption of 1,368,750 shoes. At an average weight of 21 pounds each, new, the total weight is 28,743,750 pounds; at 2 cents per pound, amounting to $574,875. I will deduct from these amounts an average weight, per shoe, of 9 pounds when worn out, amounting to 12,318,750 pounds of scrap, at ½ cent per pound, equal to $41,062, leaving a net balance of $533,813. This represents what we pay

annually for metal actually ground to dust braking our cars. To this we must add the cost of labor in changing the shoes. Allowing 30 minutes per sboe for replacement and adjustment of rods, etc., and $2 per ten hours per day for labor, this total amount charged would be $136,875. Adding this last figure to the net cost of metal gives us the total annual charge of $670,688 for brake shoes, equal to about $13.70 per average car, from which you can roughly estimate the cost of this item for your respective roads.

It is evident that if you select a metal which will give you a greater car mileage than 5,000 miles, or a shape which will permit you to use more of your 21 pounds of new shoes than 12 pounds for braking, and, therefore, less than 9 pounds for scrap, or if your shape is readily adjustable on cars, and your men become familiar with their replacement and save time—if you do any one of these a saving results, and if you do two or all, the saving is so much the more increased.

Figs. 3 and 4 show the principal points of the types to which reference has been made.

## Storage Batteries for Electric Traction.[1]

By Pedro G. Salom.

The use of storage batteries for electric traction, and more particularly for operating street cars, has been so thoroughly discussed and so universally condemned by

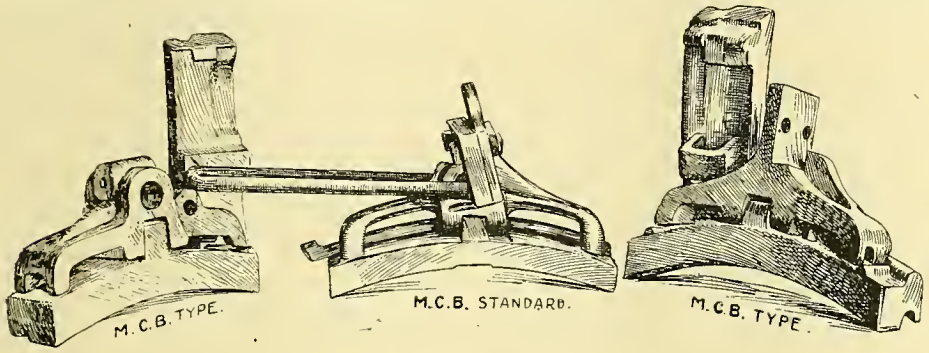



FIG. 3. BRAKE SHOES.

electrical engineers and practical business men engaged in the operation of street car lines that it requires some courage in the face of such a widespread belief to uge that these gentlemen can all be mistaken, and yet a careful study of the problem, extending over a period of eight years, compels the author not only to dissent from their views, but to assert that in his opinion storage battery traction in the streets of our great cities will be well nigh universal. All the wires and poles must come down and the costly investment in underground feeders and mains be dispensed with. We are led to these conclusions by the following considerations:

Assuming, for the sake of argument, that electric storage traction is practicable, what are the problems that confront the engineer? The first and most important is the life of the battery. Then come the capacity, the rate of discharge, the weight and size of the elements, the loss of power in the various transmissions between the prime mover and the axle, the distance or total length of line, the grade and curves and the speed.

In traction work there is only one reliable method of determining the life of the battery, and that is on the basis of car mileage. It is nonsense to talk about batteries lasting eight months or eighteen months unless there is a record, at the same time, of the amount of work accomplished, measured in electrical horse power hours. The highest record yet obtained, of which the writer has any reliable knowledge, is that of a single set of 108 accumulators making over 6,000 miles. This record was made under the most trying and unfavorable circumstances. Assuming that the battery could make 100 miles per day, this would mean that the positive plates of the battery would have to be renewed every two months; if 50 miles per day, then the life would cover a period of four months; at 25 miles per day, eight months, and so on. It can thus be readily understood that the bare statement that a battery would last six or eight months does not convey a correct idea of the real life of the battery.

Let us see what it would cost to run 6,000 miles with a single set of accumulators, or, since two sets are always employed, one being charged while the other is in service, we will make a calculation on a basis of 12,000 miles.

| | |
|---|---|
| 216 positive groups at $2.50 | $540 00 |
| Credit 2,592 pounds lead scrap at 3 cents | 77 76 |
| Balance | $462 24 |

$462.24 ÷ 12,000 = 3.85 cents per car mile.

If positive groups were renewed at $1.25 per group, instead of $2.50 each, which it would be perfectly possible to do, leaving out the question of patents and royalties, then the cost per car mile would only be 1.6 cents.

What amount of work is represented by these 6,000 miles, so far as the accumulators are concerned? It was found by keeping the most careful records on the Fourth avenue line at New York that the amount of energy consumed per car mile was about 1½ electrical horse power hours. That is to say, that after making a round trip of 11½ miles, it required about 17 electrical horse power hours to replace the energy drawn from the batteries. Six thousand miles would, therefore, require 9,000 electrical horse power hours, and since a battery of 108 cells has a capacity of 54 electrical horse power hours for each total discharge, if we divide 9,000 by 54 we get 166 total discharges that are required of the battery before the positive plates break down. Anyone who has had any extensive experience with storage batteries knows that this is a very conservative estimate of the amount of work that a good battery will perform.

It may be asked, Have there been no improvements in late years with a view of diminishing the number and weight of batteries required to propel a car? We regret to have to answer no, and this brings us to the consideration of the limitations of storage batteries. We have said that it requires about 1½ electrical horse power hours per car mile, and that 108 accumulators are used and necessary for a 12-mile run, and they have a capacity of 54 electrical horse power hours, or three round trips.

Why is it not possible to use a battery with one-third the weight? Simply because the weight of battery required is not according to the total amount of work to be done, but according to the rate at which it is to be done. Let us go back to our 12-mile run again. This requires 1½ electrical horse power hours per car mile, or 1,119 watt hours, and since the electromotive force is about 225 volts, this would be equivalent to nearly five ampere hours per mile, or 60 ampere hours for the round trip; and since the trip consumes two hours' time, this is an average rate of discharge of 30 amperes all the time.

Of course, it is very much greater than this at times, when the car starts, or is going up steep grades, when the battery is frequently called upon for a rate of discharge of over 100 amperes. Now, if we were to use a small battery of less total capacity, there would not be sufficient area of active material exposed to develop such a current, the electromotive force would drop and the car stop running. This is the trouble with all thick plate batteries in traction work. The amount of surface area exposed is comparatively small for the weight of battery.

It seems to the writer, in view of the facts just stated, and which are indisputable, that the introduction of storage traction for surface roads in large cities is inevitable. The trolley may be introduced at the present time, pending the solution of the difficulties under which storage batteries have come into disrepute, but that it can obtain, in the long run, against the many and obvious advantages of the storage system is unlikely. Let the public once understand that there are no insurmountable difficulties connected with the storage system, beyond the fact that it costs a few cents more per car mile than the trolley, and the demand for its introduction will be irresistible.

The public are not interested in the cheapest and most objectionable method of transit, especially where they derive no benefit from the economies effected, but they are interested in and entitled to a safe, reliable and absolutely unobjectionable method of transit, which is cheaper than horses at the present time, and which may, in a few years, from the further knowledge and experience gained by actual use, almost, if not quite, compete in cost with the trolley.

It is absolutely certain that all power houses for trolley lines will be compelled to introduce storage batteries for equalizing their loads. As at present operated, the power houses are called upon without a moment's notice to supply power varying from 50 to 500 horse power. This can be accomplished only by employing large units, and the economic losses arising from operating large units at less than their maximum loads are too well known to require comment. Storage batteries will gradually be introduced, first for running night cars, which will permit of the power plant being shut down after 12 o'clock, and, finally, on the day cars, as the efficiency of a large power plant operated with a constant load, day after day, charging batteries, and the saving in cost and maintenance of the line will more than counterbalance the cost of renewals of positive plates.

The most successful application of storage batteries for power purposes, up to the present time, is in electric launches. This method of navigation for inland waters was first demonstrated on a large scale at the World's Fair at Chicago last year, when 54 electric launches were in daily operation, and carried during the six months of the exhibition upward of one million passengers.

Another, and possibly more important, use than any yet attempted, is the propulsion of all kinds of vehicles with storage batteries. Street cars number but a handful compared with all the carriages, wagons, carts and drays that are employed daily for the various purposes of local transportation. The successful introduction of electrically propelled vehicles is simply a question of good pavements and good roads. The cost of operating such vehicles would be far less than with horses.

For example, a battery of 60 accumulators of 80 ampere hours' capacity, capable of a maximum development of three horse power, would cost at the present time $427.50, a three horse power motor $200, making $627.50, or 10 cents per day interest on the investment. The electrical capacity would be 9,600 watt hours, or about 13 horse power hours. To propel a vehicle weighing about two tons on good, level roads, at 10 miles per hour, would require about four horse power. The battery would, therefore, have a capacity for at least three hours' work, or a 30-mile run at maximum speed, and over 50 miles at normal or slow speed. Thirteen horse power can readily be generated at the rate of two cents per horse power per hour, or 26 cents. Assuming that the positive plates would last 200 days and make 6,000 miles, or an average of 30 miles per day, the cost for renewals would be about 75 cents per day, making the total operating expenses $1 per day for 30 miles, or 3⅓ cents per mile. Such a vehicle would do the work of several horses, but even if it replaced only two, it would be far cheaper in the long run than operating with horses.

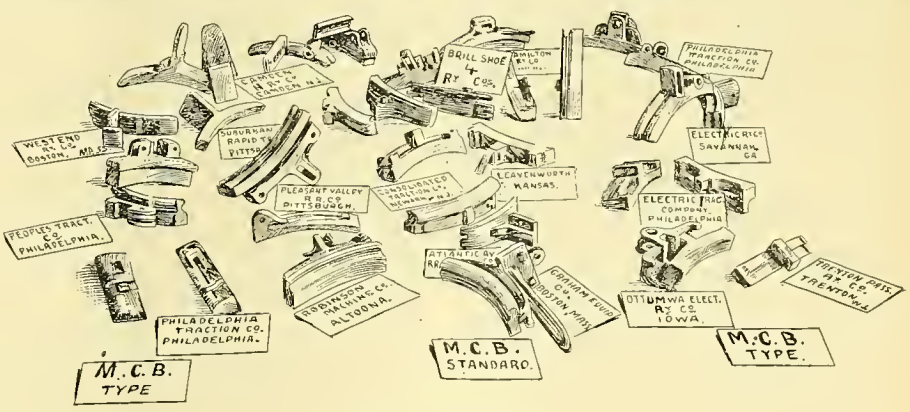



FIG. 4. BRAKE SHOES.

## Association of Practical Electricians.

The recently incorporated Association of Practical Electricians, Chicago, announces that it has thirty active members on its roll and that its plans for work have been decided upon. The officers of the association are: President, George E. Sanford; vice-president, G. H. Jacobs; recording secretary, J. L. Hagadorn; financial secretary, G. H. Farrar. The association has arranged a course of study which will be conducted under the direction of competent instructors, and a series of lectures will be delivered in connection with these studies. The objects of the organization are praiseworthy and deserving of encouragement.

## An English Estimate of Edison.

[From the London *Electrical Review.*]

The position which Edison fills in the popular mind is one of the most remarkable incidents in the history of invention. To many he is the embodied genius of electric lighting, and he is the popular conception of the greatest living scientist, but the fact is that the lustre of America's real scientist has been paled by the glare and artifical glamor surrounding Edison and all his works. These distorted views have been to a great extent fostered by ingenious mechanical contrivances, such as the phonograph and other novelties, which are above all things amusing. It would be idle for us to say that he has done nothing of note; he is undoubtedly a clever man, but there are many who are better electricians, and more who are better mechanics. His ability lies rather in organizing the work of a staff of trained experts, which, in its way, is unequaled. Edison has allied with his mechanical skill men of remarkable business aptitude. It is this combination of talents which has doubtless raised him above the majority of men. There are men possessing greater skill in mechanics, and men with greater commercial gifts, but the two are seldom combined. We are not called upon to analyze his extraordinary popularity. He doubtless has deserved it. But a moderate estimate would be that he is a practical, shrewd man, with (what we believe is too generally underrated) immense physical endurance, and, consequently, with infinite capacity for work and an untiring energy.

The plant of the Home Electric Light & Power company of Elkhart, Ind., was seriously damaged on October 29th by the bursting of a fly-wheel. This is a water power plant, and the accident is said to be due to defective regulation.

1. From *Cassier's Magazine.*

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HIGH WATER MARK

CIRCULATION, 16,630.

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THE electrical interests of New York are to be congratulated. The favorable vote on the rapid transit proposition will insure the construction of an electrically operated underground road, and the adoption of the constitutional amendments encourages the belief that the necessary improvements on the Erie canal will be made at once so as to allow the introduction of an electrical system of propulsion. The electric lighting interests of New York city will not mourn the defeat of Grant in the mayoralty contest. His policy, during former administrations, in his dealings with the electrical corporations, was generally narrow and undignified.

THROUGH the co-operation of the local electric street railway company, the postmaster at Rochester, N. Y., has been able to devise a scheme for improving the postal service of that city. Special tickets have been prepared for the mail carriers, resembling in some respects the transfer ticket. Each carrier is provided with a package of the tickets, which are to be used on evening or morning routes as the case may be, the date and hour being punched out by the conductor and the slip torn off, leaving the stub marked with the carrier's number. By this system the postal authorities will be able to avail themselves of all the advantages to be derived from rapid transit for the extension of the free delivery system and in the frequency of collection of the drop-letter boxes. As soon as the schedule of the hours of collection can be perfected under this new system, time cards will be placed on the boxes, showing hours of collection and arrival at the postoffice. Rochester is peculiarly fortunate in having a street railway system that covers every portion of the city, the network of lines radiating from one central point and extending far into the suburbs. Some of the lines pass the postoffice and all of them run to points within two minutes' walk of that building. Many other cities might make similar arrangements. It would certainly prove a great convenience to the communities in which the service would be established.

A NEWLY organized street railway company has petitioned the Chicago city council for a franchise, and in consideration it agrees to equip its lines with "the finest electric trains on earth," sell six tickets for 25 cents, issue transfers wherever the mayor directs, pave the streets it occupies from curb to curb, heat its cars from the first day of November until the last day of February, and carry passengers for one fare from the stockyards to Lincoln Park. A list of the streets upon which the company asks for franchises shows that it proposes to compete with the North and West Chicago companies' lines, and it is believed on this account the council may hesitate about passing the ordinance.

IF the proposed purchase of the Brazilian telegraph system by the government is accomplished, it is promised that it will put an end to the monoply enjoyed by the English cable companies in communicating with Brazil, and open a way for cheaper and more direct telegraphic communication between the United States and Brazil. All telegrams from Brazil have heretofore been obliged to cross the Atlantic twice in order to reach the United States, and a prohibitory discriminating rate has been charged upon all American messages entering Brazil by any other route than that controlled by the English monopoly. Under the proposed measure the government is authorized to purchase at once the Western & Brazilian Telegraph company's lines and equipment, and to issue in payment special telegraph bonds bearing five per cent. interest.

WE look to our esteemed English contemporary, the *Electrician* of London, for careful and exact information of the various applications of electrical energy (not about electricity, observe, for the *Electrician* avers, if we remember rightly, that it knows nothing of electricity and that it avoids the use of the word in its editorial columns), but it is only at rare intervals that our contemporary enlivens its columns with the gleam of a merry jest. Not that "the oldest electrical journal" is dull or lacking in appreciation of drollery. Far from it; for was it not the *Electrician* that demurely expressed its wonder that, "with so little apparent capacity present anywhere, the retardation should attain such enormous dimensions," in the case of the Spanish telegraph authorities who were three days and over in transmitting a message one hundred miles? Still, as we say, it is but seldom that our contemporary unbends its scientific dignity sufficiently to crack a joke. But there was an undoubted bit "in lighter vein" in the issue of November 2d, although it rather shamefacedly masqueraded under the title "Electric Quackery." Here it is:

Speaking of the electric current in relation to health, a Chicago newspaper says that it knows of a woman who has "gained twenty pounds by the use of her battery." That is nothing: we know of a man who has gained thousands of pounds by other people using his battery.

This paragraph is simply a piece of frivolity, and is deliberately printed as such. Our contemporary not only can be, but is, humorous as well as profound. Sprightliness, judiciously controlled, is ever engaging, and so we reprint our contemporary's joke and congratulate it.

AMONG the many side issues that were introduced in the recent campaign in New York was one in which the American Bell Telephone company was deeply interested. It will be remembered that a determined effort was made last winter to secure the passage of a bill by the Legislature regulating telephone charges. Several measures were proposed, and one—the Gerst bill—was taken up by the Board of Trade and Transportation of New York, and the friends of the other measures fell into line and advocated its passage. The bill was sent to a committee, and an attempt was made to smother it, but Mr. Gerst, its author, made a spirited fight on the floor of the Assembly and succeeded in securing a vote, which, though not on the measure itself, still showed the attitude of the members toward the movement. Those who voted against the bill and those who did not vote at all were remembered by the advocates of the proposed legislation, and when they came up for re-election they were vigorously opposed. The Board of Trade and Transportation made a vigorous fight and did not confine its efforts to New York city alone. Telephone subscribers in every city in the state were enlisted in the movement and candidates were required to announce their views on the subject. It is a remarkable fact that nearly all the men who opposed the Gerst bill were defeated, and there is no doubt that their retirement was brought about largely by this influence. It is to be expected that when the new Legislature is called upon to pass a bill regulating telephone charges the measure will receive much more favorable consideration than has heretofore been accorded to bills of that character.

THE present outlook for a Pacific cable is promising, and the English, Canadian and Australian capitalists interested are much encouraged by recent developments. A dispatch from Ottawa, Ont., dated November 10th, announces that six bids have been received by the Canadian minister of trade from English cable manufacturers for the construction and maintenance of the proposed line. The figures have not been published, but it is announced that in every case they are below the estimates made by the engineer. No objection was offered to the length of the link between Vancouver and Fanning Island, the point designated as a landing place for the cable if a suitable one can not be had in the Hawaiian group. It is not expected that permission will be granted to land at Honolulu, although the projectors of the enterprise are still hopeful that some arrangement may be made. A recent dispatch from San Francisco announced that Mr. Mercer, of the British colonial office, and Sandford Fleming, the representative of Canada, had returned from Hawaii, where they had been negotiating with the government of that country for the concession of a landing place and telegraph station for the projected Pacific cable. Mr. Fleming said that the Hawaiian treaty with the United States precluded the concession of any land or any special rights to any other country. The British commissioners had agreed not to fortify the cable station nor to create a naval station. Mr. Fleming added that it was understood Hawaii would appeal to Washington for permission to grant the privilege asked for by Great Britain in respect to the land concession. The commissioners, while on their journey, inspected Bird Island, and made the necessary soundings in the vicinity. They announced their intention to proceed to Washington to urge their case with the United States government.

THAT electrical engineers and inventors have not given up the idea of perfecting a system of electrical propulsion to take the place of the overhead trolley in large cities is shown by the interest that is manifested in the experiments with storage battery and conduit lines. A valuable paper has been contributed by Joseph Sachs on the conduit systems, which is presented in this issue. The author reviews the work that has already been done in this line, and points out what in his estimation are the most important defects in the systems that have already been submitted. Thus far a commercially successful conduit system has not been perfected, at least the practicability of any system has not been demonstrated. It is true that all the conduit schemes have not been proven failures, and it may be that among those which have not been thoroughly tested there may be one that will solve the problem. Mr. Sachs believes that the large number of failures in this field can be explained by the fact that every novice turns his attention to this problem, and that most of those who have undertaken its solution have not fully understood the obstacles which they must encounter. Mr. Salom's paper on "Storage Batteries for Electric Traction," which is also presented in another column, is of special interest in this connection. It is conceded that the storage battery is at a disadvantage in any competition with the trolley, as far as cost is concerned, but Mr. Salom believes that the public will disregard this fact and insist upon the companies discarding the trolley for the storage battery. It might be just as well for storage battery men to dismiss any such considerations. If they hope to compete with the trolley and the conduit systems, they must increase the efficiency of their batteries, reduce the cost of manufacture and maintenance, and improve the service in every way. The excellent service which the trolley is giving in every part of the country, and the improvements that are constantly being made, are doing much to remove popular prejudice against it.

Attention is also called to the fact that storage batteries can be used in connection with trolley cars at the power houses for equalizing the loads, and also for running night cars, which will permit of the power plant being shut down after twelve o'clock, and, Mr. Salom adds, on the day cars, as the efficiency of a large power plant operated with a constant load, day after day, charging batteries, and the saving in cost and maintenance of the line, will more than counterbalance the cost of renewals of positive plates.

## Is There a Solution of the Electric Conduit Railway Problem?[1]

By Joseph Sachs.

It is scarcely a dozen years ago when we did not even have a single inch, I may say, of electric railway in existence. To-day there are hundreds of miles in this country alone; but, strange to say, although its advance has been most phenomenal and the success of the so-called "deadly trolley" has been very great, there has existed a most extensive demand for a substitute for the trolley, which should be free from the various objections which are inherent in the overhead wire. The main objection thats exist is the overhead wire, and although we have advanced in the construction and operating of motors and gearing and power house machinery, we still remain at the same point that we did at the very begioning in the method of distributing the power to the motor of the car, namely, by means of an overhead bare wire. Now two substiutes have appeared to solve this problem; one has been the storage battery and the other has been the underground or conduit system. The storage battery car does not need to be explained; you are all familiar with it, and I need only say that although the storage battery has proved a failure in the past, and a severe loss to many of those who have invested money in enterprises of that kind, recent successes in that direction lead us to believe that it is more than a possibility, in fact a very great probability, that we may have a very successful storage battery system in the very near future. But the point that I have under consideration to-night is not to solve the problem in that way, but to solve it by a center of distribution method, or a central station method, and the way to solve the problem in that way is by the conduit system.

Hundreds of conduits have been tried; thousands of them, I may say. And I may also say that perhaps no other branch of electrical engineering can boast of the vast variety of systems and plans that have been developed by various promoters as the class of conduit electric railways; in fact, of all the electric railway patents in the Patent Office to-day, over one-half are conduit railway systems; that includes locomotives, storage batteries and everything else that appertains to electric railways. It may seem strange, but perhaps the first thing the novice in electrical engineering goes at is a conduit electric railway. Perhaps that is the very reason why so many have not been so successful.

Why is it that success has not been obtained? One reason I have perhaps given you; the other is perhaps on account of some inherent difficulties, and another still is perhaps the extreme large cost of construction and maintenance, although the maintenance would seem to be less than the trolley.

From the fact that there are in operation to-day two electric conduit systems it would appear that we could build other systems of similar character and somewhat similar construction and have them work successfully; but up to date nothing that has been successful, on a commercial basis, has been forthcoming. I think that in order to bring forth a successful system we must first study the problem most thoroughly and the real question to be solved.

I have taken up the various systems that have been devised and divided them into six classes, and have selected some which I shall describe to you in their classes, and show you their points of advantage and disadvantage.

We shall first take up the open slot continuous wire conduits.

The first system which I shall consider will be the well known Bentley-Knight system, which was, as you all well know, one of the first attempts ever made in this country to solve the rapid transit problem by means of electricity. It consisted of a very small open-slotted conduit with two wires suspended therein. The conduit was exceedingly small and, although this road was operated for some time, it was at last abandoned. The road was opened in 1884, about ten years ago, and, as I say, was the first attempt at electric traction on a commercial operative basis in this country.

The Bentley-Knight people, however, were not satisfied with that attempt and got out another system. It had also a very small conduit, but instead of placing it in the middle of the track it was located at the side of the rail. Two wires were located therein and the plow coming down from the car came in contact with the wires, one on each side.

Another conduit was installed as early as 1885, and although the apparent conditions would be against its successful operation, strange to say it is operating to-day and paying dividends. I have reference to the Blackpool system or Blackpool conduit, which is operated in Blackpool, England, to-day. The conduit is exceedingly small, and the two wires are supported nearly directly below the slot, yet, as I say, the conduit is in daily operation.

The next system to be described is the far-famed Siemens-Halske system, which is being operated to-day at Budapest. The conduit is a peculiar one. It is located directly beneath the rail. The car wheel is very dissimilar from that used in this country. It is a central flange one, the flange running between the two rails, the object being to keep the slots open at all times. Two wires are used, one each side of the slot, and the whole space around the conduit is filled up and protected by cement. Strange to say, this conduit has been in daily operation, since 1889; dividends are paid by the road, and sixty cars are operating on six miles of double track. But I doubt very much whether a conduit of that size would operate in this country.

Now we come to the latest addition to open-slot conduits, which is proving more or less successful. I have reference to what is called the Love conduit. The yoke is a construction adopted at Chicago, where this system was first introduced. You see the promoters of this system had a better idea of the problem to be solved. We have here a large conduit and the wire placed high and dry; and furthermore, about the most important thing of the system is that the wire is accessible by placing above the wire a detachable slot rail or cover which can be raised at any time so that the wire can be inspected. But apparently it did not prove satisfactory for some reason or other, and when the same system was introduced in Washington they adopted another form of construction. One reason, no doubt, was that a cheap conduit was wanted, which seemed to be the underlying principle of this whole matter, and for that reason the heavy yoke was replaced by a simple trough located between the tracks. This conduit, I understand, is to-day in operation in Washington; whether fully successful or not I do not know.

Now we come to some of the possibilities and suggestions. One is the Griffin conduit, the only feature of which consists in the fact that the conduit is divided into two compartments, one for the wire and the other for drainage. The advantage of the last form of construction you can readily see for yourself and is also borne out in the form of construction which is called the Zell conduit, in which we have a drainage tube in the center beneath the slot, and the wire is supported in two separate compartments, one on each side of the drainage tube. Both of these systems, as I say, are suggestions.

Here are some more suggestions, one of which is very similar to the Bentley-Knight construction. A very complete and well designed conduit is that devised by Elias Ries as far back as 1887. The other is an oddity. The wire is simply loosely supported on insulators and the trolley wheels pass under the wire and raise it up as it comes along, and after the collector has passed the wire drops back into its supports.

Now you will please take notice that most of these various forms of open-slot conduit possess several points of disadvantage. In nearly all the forms which have been tried the conduit has been extremely small; the wires have been unprotected and poorly located; they have been placed low instead of high; the insulators have been poor and inaccessible, and the problem seems to have been attacked from the wrong standpoint, namely, to get a cheap system to compete with the trolley.

We will leave the open-slot conduit for a while and take up what we call the movable lip or cover conduit. In this form of construction the aim has been to protect the wire, and in order to do that several inventors have attempted to cover up the slot to keep the slush, mud and dirt out, except when the trolley is passing. One of the best known of this kind is the VanDepoele conduit, the invention of the late well-known electrician Mr. VanDepoele. He devised a form of construction having flexible lips, which cover the slot of the conduit containing the wire. The conduit is very small, and there are two lips which press together over the slot and which are pushed aside by the plow of the car as it comes along, but close again after the car has passed.

In another form which Mr. VanDepoele has devised, he puts the same construction inside of a somewhat larger conduit, and there the same thing goes on.

In another form the wire is located in a trough within the slotted conduit and covered by two shutters which are pushed aside by the plow. These shutters are made in short sections and cover up again after the plow has passed.

Now we come to another system which has recently been exploited in this country, which is called the Patterson system. The conduit is very small, and divided into two compartments. The wires are located in one compartment and there is a cover which is pushed aside by the plow.

The difficulty with these open-slot flexible cover or movable cover conduits is practically the same as the previous class and possesses the additional disadvantage that we have not got the flexible material that will stand the strain of every-day railway traffic, and the shutters when made of metal cause a great deal of noise and do not seem to afford a great deal of protection against injury to the wire.

The next class we come to is known as the surface contact system. It holds forth certain alluring attractions in the way of cheap first cost and dispensing with the open-slot, and has therefore received a great deal of attention. The Lineff system of this class has been tried experimentally. It consists of a sectional iron contact rail which is flush with the street surface. It is made in sections of six to ten feet, placed on top of the conduit, which is entirely closed and is composed of some insulating material in which is laid a strip of copper, attached to the bottom of which is a strip of iron, and this composite strip is connected with the source of supply. Upon the car is a magnet having a wheel at each end, and is placed longitudinally with the track. When the magnet is energized the composite strip is attracted up against the rail and naturally connects that section of the rail with the dynamo; and as the car moves along the magnet pull up the strips in succession and connects each successive section of the contact rail with the source of supply. I will not dwell any longer on this system, as I have a number of others to describe.

There is another surface contact system devised by Mr. VanDepoele which is practically the same in principle. The contact conductor consists of a number of sections on the surface of the street; the contact device or collecting plow consists of a magnet, the poles of which are brushes. The switching device is a small car which runs upon rails in the conduit and directly beneath the sectional contacts. The lower rails form the supply conductor and the car acts as a connection between it and the section above. As the motor car runs along the magnet beneath pulls the little car through the conduit, and thereby connects each successive section with the supply wire.

In another system of Mr. VanDepoele's there are a number of levers inside of the conduit beneath the sectional conductor, and as the magnet moves along the switch levers are pulled up against the respective sections, and in that way the contact is made all along the line in each section of surface contact conductor. After the car has passed and the magnet passed the section the lever beneath will drop back and disconnect.

Lieutenant Patten's system is very much the same as the Lineff system. It consists of a band of iron and upon the car is mounted a magnet, the difference being that this magnet is placed transversely instead of longitudinally to the track. The band is pulled up against the rail by the magnet which forms the magnetic switching medium, and also against a central contact, which forms the sectional conductor.

Messrs. McElroy, Nicholson and McTighe have devised a system in which instead of using a sectional rail contact, plates are used which are located between the track on boxes in which the switch mechanism is located. The poles of the magnet are very long and project from the plate on one box to the next. In the box a small lever is pivoted and connected to the supply wire. When a magnet on the car is over the box the lever is attracted up against the contact plate and connects it with the supply wire, and the current is taken off by the long bar which forms the pole of the magnet. As will be understood the long bar is long enough to span two contact plates.

Another system in which the boxes are located in the center of the track was devised by the same inventors. Instead of having a lever, an electro-magnet is used and the current is sent down through each successive contact head and through the magnet and the connection made between the contact plate and supply wire, just as it would be in the magnetic switch by the magnetic plow. Instead of using a magnet at the bottom of the car a brush is used or contact bar. The current is sent down through the head into the magnet, which then pulls up the switching device at the bottom, instead of it being directly operated by the magnet on the car.

There is a system which I have had a little experience with and which has made me a little doubtful respecting the ultimate success of the surface contact system. It is a system in which very much the same methods were adopted as in the McElroy, Nicholson and McTighe system As in the last system described contact plates are used, but the electro-magnets are not placed under the plates but in accessible man-holes or placed upon posts along the road. A number of them controlling a section were grouped together. The brush, which is under the car, is always in contact with two or more heads. One head is energized, and when that has been energized, why, the last one is dropped. The conduit really consists merely of a small trough in which the wires were run to the various switching magnets, which were all located together. The system was originally an invention of G. T. Woods.

There is another class or system; in fact, it might be called a combination of systems, combining the magnetic arrangement of surface contact with the electro-magnetic. One of these is the Siemens system. Contact plates are used and the switching mechanism therein consists of a pivoted lever which is first attracted by the magnet on the car and after the plate has been connected the current passes around a coil of wire on the lever and magnetizes it.

There is another system devised by Lieut. Patten in which practically the same method is adopted. The switching device is so arranged as to improve the magnetic circuit. A separate contact rail is used as the contact conductor.

What is perhaps the latest attempt, in the surface contact system of the Johnson-Lundell type, is very similar to the system in which the magnetic switches are all grouped together. A sectional rail is used instead of contact plates.

The peculiarities of this system are that the car is also equipped with a storage battery, so that in case the brush under the car loses contact with any section of the contact rail, the car is simply operated by the storage battery. The battery is also used to actuate the magnetic switch if it should be de-energized.

Other surface contact systems have also been devised by Gorden, Pollak and Binswanger, Schuckert and others. In the last named system iron fillings are used as the switching medium in the same way as the levers are used in one of the systems described.

I will not dwell on the advantage or disadvantage of the surface contact systems. The claim put forth by their promoters is that they dispense with the open slot and can be installed cheaper than any such system. However, on the other side, we have the difficulty of keeping down the leakage of the section that may be alive; the complicated mechanism and the many parts and the uncertainty of action which always attends the operation of a number of small mechanisms would seem to seriously defer the ultimate success of such systems.

In addition there is the open conduit class in which, instead of having a continuous wire, a sectional conductor is used; that is, only a section of the contact conductor is connected with the supply wire, and magnetic, electro-magnetic or mechanical switches may be used. We could, for instance, take any of the sectional conductor systems and place the contact rail or plate within a slotted conduit.

The switching of the various sections, plates or contact points can, however, also be accomplished by mechanical devices operated by the moving car.

The Lawrence system has mechanical switch boxes. The contact rail is composed of small T rails supported on a pivoted lever, one end of which is connected with the switch piston. The trolley comes down upon the conductor, and by depressing one end of the lever supporting the rail, shoves up the other, and pushes in the switch rod, making connection with the main wire. After the collector has passed the bar springs up again, and connection is broken in the switch box for that section.

The Muncie-Coles system was experimentally tried some time ago at New Haven. Instead of using a continuously depressed rail, a number of switch boxes are used and the contact points are depressed. The conduit is very small and simply covers up the boxes.

A system which was recently exploited at Coney Island is rather a combination of ideas, but as far I can understand, it is also fundamentally due to the very fertile brain of G. T. Woods; it is practically the same as the Muncie-Coles, but the very great advantage of this is that the switching mechanism, instead of moving up and down, moves on a pivot.

A system devised by Frank M. Ashley, very much the same as the Lawrence or any of the sectional conductor systems operated mechanically, consists of a conduit, a sectional flexible rail, and the supply conductor inside of a jacket. As the connector comes along it presses up that section of the conductor and throws it in connection with the supply wire.

Now, these various forms of sectional conductor open-slot

1. Read before the New York Electrical society, November 1, 1894.

conduit systems possess, in my mind, very little advantage over the continuous wire conduit. You have the open conduit, the chance for getting mud, slush and dirt therein, and you have got to have a fairly large conduit.

Now, we come to a very peculiar system. Here the inventor has attempted to bring the conductor, not in the conduit, not on the surface, but he has gone to the other extreme and says, let me bring it above the surface, and I will have it clear and sure. So he constructs a slot parallel to the rail, along the roadbed, and places adjacent to that slot a number of switch boxes, having long arms, the contact points at the end of which run across the slot. On the car is a plow, which projects down into the slot, and a similar plow at the other end, and a connection or contact bar between the two plows. The plow goes down in the slot, catches one of the arms and raises it up. While the lever is raised in connection with the bar, current is supplied from that particular switch, and then after the car has passed by the raised contact, why, the contact simply drops back again, but another lever is always raised before the last is dropped. This would be very good if we always had clean and clear streets, and no mud, slush, dirt or snow; but inasmuch as the system has not yet been tried, I cannot say whether it will be able to operate against these or not.

In another form of raised sectional contact system, devised by Mr. Henry, the contact device is located in a box in the roadbed, and instead of having a mechanical device, you have an electro-magnetic device. A long magnet under the car attracts a plug in the box to it and makes contact therewith. After the car has passed the plug drops back and out of connection. The raising and lowering of the plug causes it to be connected and disconnected with the supply wire. The same points hold good with this system.

Now we come to another form of raised contact system, which is an exceedingly odd thing. This invention has a slotted conduit, and puts therein a flexible cable, which is supported on cross-bars. As the car goes along it raises up the flexible cable out of the slot and over rollers under the car, and after the car has passed it drops back.

The last class to be considered is what is called the induction system, in which a number of primary coils are located at regular points along the line, and upon the car is located a secondary coil, brought into such relation to the primary that a current is induced in the secondary from the primary. Although we may have the alternating current motor, the system would be very inefficient and costly. The primaries are wound upon "U" shaped cores, imbedded in the roadbed with the two ends up. The long core on the car is also "U" shaped; each end is a long brush which comes into intimate contact with the ends of the "U" in the street. As you see, the brush makes contact with one primary core before it leaves the last, and in that way a continuous alternating current is induced and the car is supposed to move; it has not as yet, though.

What is, perhaps, the first surface contact system installed in the country was put in by the Baltimore Traction company in 1885. The road was equipped with Daft motors, installed by the Daft company, but instead of an overhead wire it had a T rail in the center of the track supported by suitable insulators. The car was operated through streets in which there was not much traffic, but there was only 250 to 300 volts. This system is not in operation at present.

Now, as you see from the variety of possibilities and probabilities that I have shown, the solution of the conduit electric railway problem is not at all limited, and all you have got to do is to pay your money and take your choice; but the peculiar part of it all is that there is not much choice to make, because apparently nothing has ever been evolved—nothing commercially practical—except the plain, every-day open conduit and the continuous wire. That simply means that it has many points of superiority, because it is actually in operation and nothing else has ever been operated. We have such a system in operation at Budapest and at Blackpool, England; but it is doubtful whether either of these systems can be made operative in this country. The climatic conditions are different, and it is doubtful whether our American streets are quite up to some, at least, of the streets in Budapest, in which one of the systems is in operation.

Various advantages are claimed for the different systems that have been suggested as a substitute for the open-slot conduit. They may obviate some of the disadvantages of the open-slot conduit with the continuous wire; they may claim to possess certain advantages in the way of costs and other considerations which are even less apparent than that of cost, but they have other objections, and very strong objections, which, I think, put them far behind any open-slot conduit system, although I do not mean to say that such systems—that is, those other than the open-slot conduit—cannot be made operative.

But let us return to the open-slot conduit systems that have been tried and installed. What do we find? We find, in the first place, a very small conduit poorly constructed. The wires are located in very poor positions and badly protected. The drainage is exceedingly poor and the voltage is exceedingly high. The last state existed when attempts were made that failed, although in others that have succeeded the voltage is low, being about 300 volts. The aim has always been to produce a cheap system, a system which will compete with the trolley. This is a very desirable aim, but not one that is absolutely necessary, and from the fact that cable traction companies will put in cable systems where the track construction costs alone very nearly $100,000 per mile, single track, as in this city, I think we can afford to spend quite a little on a conduit system which will operate as well as the cable system and certainly has advantages which the cable has not. The problem is, primarily, one of mechanical construction of the conduit. We must get a large conduit, a dry conduit; we must place the wires in such positions as to make them high and dry and various other conditions must be studied, and it seems to me that it is rather a rebuke to electrical engineers that they have not been able to devise, or have not devised, or that some philanthropic man or corporation has not advanced the interest of the conduit system; but they have not. Let us take the cable conduit, for instance, and those that have recently been built are certainly excellent conduits, and what do we want to do? If we look at the problem thoroughly, we want, in the first place, as previously mentioned, to put the wire high and dry and protect it; the insulators must be far apart and located in man-holes or pits; they must be far apart; the contact should be an underbearing one, the voltage should be as low as the first cost of the plant will permit, in fact, below 300 volts if possible, for reasons which I will bring out hereafter; and if possible we should use at a low voltage the structure as a return. I believe that those points can be met and that a system containing them can very readily be devised; in fact, C. H. Warner, an electrical engineer of this city, and myself, some time ago, attempted to attack that problem. We were striving for the $50,000 prize and we have not as yet gotten it. We devised a form of conduit, taking the ordinary Broadway conduit, in this city, with which you are all familiar, and we got up an insulator which consisted of a central core of insulating materials, in which was imbedded a stud or bolt. On the core of insulating material were placed a number of petticoats of enamelled metal and separated from one another.

A number of these were placed on the core and clamped by the oil cup at the bottom through which the bolt passed, and the whole was fastened together by a nut on the bolt coming against the bottom of the cup, the clip being attached to the end of the bolt. The insulator was supported by arms attached to the top petticoat which came against an enlarged portion of the insulating core. You see by this arrangement a very long surface was presented for surface leakage, namely, the inside and outside of each of the petticoats and the oil in the cups. The insulators were supposed to be in the regular man-holes and were located at thirty feet apart and the wire was supposed to be sustained; the contact was supposed to be an underbearing one.

Now the main electrical point in the system is the voltage. If we can get the voltage low enough, why, we may put the conductor on the surface of the street, as Mr. Edison proposed some time ago. There are various methods of producing low voltage, and one of them is the method which has been adopted by the General Electric company recently, to supply the ordinary overhead trolley system. It consists in applying the three-wire system to the electric railroad, and it can be very readily applied to conduit construction in this way. We can take an ordinary conduit, such as the Broadway conduit is, or any other, and let the structure itself be the neutral wire. Suppose we use about 300 volts now, we put, as you know, in many conduit systems two wires, an outgoing wire and return wire; now all we employ here are two wires, one forms a negative, one a positive, and the structure the neutral, and by alternately connecting between the neutral and one side and the neutral and the other side we can balance up our three-wire system fairly well without very much additional devices, because, don't you see, although one car may be stopping and the other could be going at full speed and another upgrade, still for all that we can get a fairly even distribution and fairly even balance. We can also have a double track system with one set of three wires. For instance, the plus wire in one conduit of one track and the minus wire in the other, the structure being the neutral. In that way we could really have the voltage about 250 for actual work, while we would have a 500 volt distribution. If the Edison Illuminating company can afford to spend millions in installing underground three-wire feeders at 220 volts, for furnishing hundreds of horse power in lights, it certainly seems possible that electric railway companies, whose dividends are just as high if not higher, could afford to put in a system at the same voltage or perhaps somewhat higher voltage, and perhaps in that way something successful may be done.

But we have a most promising thing in the alternating system. As you all well know, the voltage possible is unlimited. We can reduce from 10 volts to 1-10th or from 10,000 volts to 100 volts, but the question again has been the motor, and I want to explain to you this evening various methods, and make suggestions in which the alternating system can perhaps be operated, even with the present system of motors through an ordinary open-slot conduit, by converters located along the line and taking the current from secondary wires, which would be of perhaps 100 volts or slightly above, any way not much more than 100. One of the methods is this: We can use a single phase or multiphase system and we can put upon the car a synchronous motor. This synchronous motor is operated continuously, and when the car is doing no work is taking practically very little current. To connect and disconnect the motor from the axle we can get up some mechanical gear to reduce or connect this kind of motor to axle. We may also perhaps devise a hydraulic gearing. There is a third system which seems to be very promising. It consists in putting in a pneumatic gear between motor and axle. Now, I think we can use one of these gears, either the pneumatic, the hydraulic, or the purely mechanical; but if neither of these should be successful, we may be successful in another way; we can use the tri-phase system, and put in induction motors on the car and have two wires as before, the third one being the structure, the induction motor taking the current from the two wires and from the structure and being connected to the axle of the car through gears and being regulated and operated by the usual forms of regulating device for such motors.

Now we come to another system devised by H. Ward Leonard of this city. He proposed to take a synchronous motor with a single or multiphase system, operating the synchronous motor continuously, having the synchronous act as a motor-generator and transforming the alternating current into a constant current, which is used on the motors of the cars.

The only point is simply this: I do not think it is so much a question of building a system, but it is one which sounds very like this: What will it cost? The cost, it appears to me, is such that it will only insure adoption in our largest cities; but if we can build a system, I feel quite confident that it is wanted. I am borne out in that direction by eminent electrical engineers; in fact, a number of companies who are putting down their good dollars to put in such a system certainly believe that way. The cost, in my mind, will not be less than $30,000 to $40,000 per mile, single track—that is, including perhaps some cheap paving. This estimate, however, is low and not for the best construction, and assumes that there will be but very little obstruction in the way of pipes, sewers, etc. But we must not compare this with the trolley; the trolley will reign supreme in its own field, and it has certainly been of enormous value in the ten short years of its life; and to say that at the coming of the conduit system the trolley goes out is making a false prophecy, because the trolley has its own field and will stay. We will never get a conduit system which will be put in for $20,000 a mile, track and all.

In conclusion, I would say that I believe we can solve this problem. I have shown you some of the ways in which it has been attempted to solve it, and some of the ways in which it may be solved. Some of you undoubtedly have other ways. We have got to have an underground or conduit system for our large cities where they will not let us use a trolley, and from the fact that at least three companies, three large corporations, that I know of are trying the ordinary open-slot conduit, I think we will shortly see something in actual operation.

But before closing I want to speak about a system, a stretch of which will be installed upon the Lenox avenue cable road of the Metropolitan Traction company. It has been devised by the engineers of the General Electric company, has been approved by their most eminent men and contains various features, some of which I have already described. The ordinary conduit yoke is taken, and at the man-holes, thirty feet apart, placed upon suitable supports, insulators which are of rectangular form are located. They are supported in cups and embedded in sulphur; these insulators are of soapstone, and fastened to the top is an arm of iron. There being two conductors used there is no structural return. To this arm is fastened the contact conductor, which is of channel iron. The contact shoe comes down through the slot and has two arms, which press outwardly from the center, supporting the bar against the contact rails, making a continuous rubbing contact. As I said, the insulators are located in the manholes and are easily accessible; they are some distance apart, and the voltages, last of all, is low, it being intended to use about 250 to 300 volts. I want to point out the fact, without criticism, that the conductors are very nearly directly below the slot, which was apparently the objection in some of the first systems, but the peculiar construction and location of the insulators on this system may prevent any trouble from this source.

## The Electric Brake in Practice.[1]

F. B. CROCKER: All electrical engineers must feel that it has been a reproach to our profession that electric cars have killed so many people in the last few years. In fact, such accidents have been much more fatal than those due to the direct effect of the electric current; that is to say, the number of persons killed by electric current, strictly speaking, is probably far less than those killed by electric cars which were not stopped in time.

JOSEPH WETZLER: In ordinary braking by hand, when the current is shut off the wear practically ceases. But with the motor acting as a generator, the teeth would again come into action, the wear, of course, being on the opposite flanks of the gear teeth.

MR. SPERRY: We have noticed no wear whatever, and the reason for it is this, and it is made quite apparent in Table III. If you will notice, in this table the currents mentioned are really the currents used in the braking application, and they hardly more than consume the stored up energy of the moving masses of the motor. You can see that the watts delivered to the brake are very small indeed. The ordinary braking current employed to de-energize both the car and the trailer is only about fourteen amperes; it is hardly anything, you see, compared with the current used to accelerate the same car and trailer, which would probably require 40 or 50 amperes.

C. S. BRADLEY: Does the motorman ever get "rattled" and throw that switch clear over and throw off his brake, and bring in the motor current, and then throw it back again, and in that movement undertaking to stop the car, when really he is throwing the motor on?

MR. SPERRY: My experience is that an excited motorman will try to throw the lever over too hard and through the end of the controller box if he could.

MR. BRADLEY: But a motorman in the event of a great emergency and under excitement is sometimes apt to make two motions, one forward and one backward, in succession.

MR. SPERRY: I should think it possible, but I never knew it to occur, however.

W. J. HAMMER: I would like to ask Mr. Sperry a question. Mr. Sperry speaks of the braking effect of the Foucault currents on the generator. I would like to ask him what his estimate is of the percentage which is due to the Foucault current. A little over two years and a half ago, when I was in England, I had the pleasure of witnessing some experiments made by Henry E. Walter, a member of the Institute, and formerly chief electrician of the Edison Machine Works, in Goerck street, and afterward at Schenectady. He made a brake in which he employed nothing but the Foucault currents generated, and in the experiments referred to magnets were suspended underneath the cars, placed close to the rail, and by passing a heavy current through them he produced Foucault currents which he proposed to use solely for the braking effect on the car. That seems somewhat in line with the experiments which Mr. Sperry has been making, and, as he refers to the importance of it, I would like to ask him about what percentage of the braking effect he considers is due to that in his brake. These experiments of Mr. Walter that I saw were only preliminary, and were conducted on a small scale.

MR. SPERRY: I would ask the gentleman, in the experiments referred to, was the air-gap open? There was no contact?

MR. HAMMER: No, sir.

MR. SPERRY: Of course the resistance there is something

1. Discussion of paper by Elmer A. Sperry, read before the American Institute of Electrical Engineers, September 19, 1894, and published in the WESTERN ELECTRICIAN, September 29, 1894.

enormous. We have found that the reduction of the resistance at the air-gap is a great point in fully utilizing these induction currents. Table III, in the paper will give the exact percentage of any point on the curve that you may want. Taken at the knee, which occurs at 16 to 18 amperes, the pull due to magnetic adhesion is 160, and the pull actually obtained from both was 2,584. You can readily see that the Foucault currents here were by all manner of means the greater component. Just what percentage I have not figured.

JOSEPH SACHS: I notice in looking through Table III. that the effect obtained from magnetic adhesion or attraction of the brake-shoe to the magnet is but a small part of the entire retarding effect. It would seem to be possible to entirely brake the car by means of a non-magnetic armature, and simply use the currents generated therein to brake with. Apparently the greatest retardation is due to the brake maguet and shoe, acting as a dynamo. It would seem from your experiments that the friction due to magnetic attraction could be disregarded.

MR. SPERRY: I should say that such a thing would be perfectly possible. Of course there would be hardly any appreciable magnetism. But as to the question, given the flux, and of course the retardation would certainly be there, as has been shown.

MAX OSTERBERG: I would like to add one to the advantages pointed out by the speaker which seems of rather striking commercial value. The authorities in a great many cities limit the maximum speed ot the cars in the business districts to eight miles per hour. as with a higher speed sudden stops in cases of emergency become impossible. It would not be long before the maximum limit would be raised, if we could convince those entrustsd with framing the laws that with an electric braking system cars running at ten miles an hour can be stopped quicker than at present running at eight. There are about 2,600 cars running in New York, and if every car can run ten instead of eight miles, that is 25 per cent. faster, then 20 per cent., or 520 of the total number of cars can be done away with. Counting the wages ot motorman and conductor at $5 per day, it amounts to $2,600 a day, or $955,000, pretty nearly $1,000,000 per year, which the car companies in New York city alone would save.

MR. SACHS: The point I wanted to bring out is in regard to the wear of the gears, as Mr. Wetzler asked before. I notice that the actual braking energy, supplied by the motor, is very small. The brake acts like a separately excited dynamo, the exciting current being furnished by the motor. The braking effect of the motor through the gears, when acting as a dynamo, is very small, compared with the braking energy of the brake magnet and shoe, acting as a dynamo. I believe I am right in that supposition.

MR. BRADLEY: This magnet seems to be something that I never have heard of before. I have often thought of such a magnet. I would like to ask Mr. Sperry exactly how the winding runs; where is the coil located and where are the terminals?

MR. SPERRY: The coil is first wound in a large hoop, then folded back upon itself and made to surround the crescent-shaped core. The recess is contracted at the face, the coil is secured in place by a plastic material surrounding it, the upper portion of the slot being filled with metal forming a smooth metallic surface. The terminals are brought to the surface in the form of flexible wires, one of which is usually again reimbedded.

ROBERT McA. LLOYD: Mr. Sperry has given us this evening a result of an able research, and shown us some ingenious devices; but they do not satisfy me that the brake problem is solved, and for three principal reasons. First, it seems to me that this residual magnetism does not offer any security while holding a car on a steep gradient; second, Mr. Sperry has said that this apparatus is much less liable to disorder than the familiar mechanical brake, but it is not clear to me why electrical devices should be any more free from fault than mechanical devices, and so I do not see why this brake should be more perfect than a windlass brake. There may be some trouble in the switch box, or some difficulty in the motor itself, or a brush might be injured so that there would be no exciting current in the magnet. Then, in the third place, when you stop the wheels you have not necessarily stopped the car, and a great many of the accidents which occur in our cities are because the tracks are covered with a soapy kind of mud that will let a car slide along fifty feet. It is true, as Mr. Sperry has said, that most brakes are not capable of locking the wheels, but even if the wheels are locked on such a rail as we have in many of our cities, a car will slide a considerable distance, leaving grade out of account. So that in order to help ourselves, we may have to pay more attention to the track and to the wheels themselves—a turned steel tire is of course better for traction purposes than a chilled wheel. Then we ought to have both a mechanical and an electrical brake on a car, because in going down a hill if anything should happen to such a brake as this, you would be lost, and the same would be true also of a mechanical brake. It seems to me that pressure might be applied to these disks by a windlass, or some other mechanical contrivance, and make the brake just as efficient as if it were held by magnetism. On the other hand, I would like to say in answer to one of the previous speakers, that I do not think it would be practicable to use a combination of that sort as a generator; besides if you are going to do that, you might as well use the armature of the dynamo or the motor as a brake, and brake through the gears. Of course, that presents a great many difficulties, and it is not a good way of braking a car, the gears, however, not being the greatest source of difficulty. Then I would like to say that an improvement might be made in putting the disks on the armature shafts where there is gearing.

MR. SACHS: I would like to answer the previous speaker in regard to using the motor and braking the cars by means of the gears. I think that is just the point that has been tried at various times, and the point that Mr. Wetzler brought out. I think if a car were braked by means of simply short-circuiting the motor, or using it as a dynamo and retarding the car through the teeth of the gear, that in a very short time you would have no gears, I think, therefore, the principle that Mr. Sperry has brought out is a much superior one. If the retarding effect of a current in a magnetic field is used, it is certainly better to obtain this effect as Mr. Sperry does than by the motor itself through the gears. I think that the experience with the electric motor, used as a braking dynamo, has not been very successful, and I believe one of the principal reasons has been that the wear and tear upon the gears has been so great that your gears would not last.

FRANKLAND JANNUS: I have understood all through the paper of Mr. Sperry that his device was intended to bring a car to a stop, and there it ended. I suppose that he intended to have a mechanical brake in addition to this. For example, if a long hill is to be traversed, the electric brake will stop the car, but then of course the motorman will want to use his hand-brake in order to hold the car. Is not that the idea? If there is any way of using this device to let the car down, I think a little explanation of that would be very interesting.

MR. SPERRY: Mr. Lloyd mentioned tracks covered with a soapy kind of mud and the wheels of the car sliding along fifty feet, etc. I would like to call attention to the fact that in all large cities where these conditions are likly to exist, the railway companies usually use sand to give the wheels better adhesion and this incidentally helps on the brakes. For instance, to-day, when the raintall has been constant for twelve hours, I have no doubt that the Broadway cable road near us has used a number of tons of sand. Now of course their cars are propelled without traction of the wheels in any sense, still they use sand for the purpose of making their brakes effective. This is a remedy commonly adopted for slimy rails, and without it there are conditions of track where no brakes would be of service. The ordinary hand-brake may be used as a duplicate brake apparatus if required. I have, however, yet to see the first man who will wear himself out on the hand-brake when he can brake the car by simply pushing the lever and allowing electricity to do his work. As to the certainty of its acting, as I said in my paper, I do not see how anything can be more certain; every time you apply the current you necessarily test its capacity for the next brake application. In the thousands of miles per day that this brake is now running in this country, I do not know of a single failure. If a car will not run, it should be put in order, but if it runs, it brakes. As to coming down hills, that is doubtless a point that I have not made clear. The brake will not make a full stop unless you want to stop. We are operating on a long and steep hill (a mile and a quarter, I think) in Waterbury, Conn., not far from New York, and if anyone is sufficiently interested in its operation he may go up there and ride all day up and down the hill, and he will see that it performs its work well. The point that I have not made clear, I believe, and one which you can readily understand, is that I can hold the amperage in the brake circuit anywhere I choose by simply manipulating the lever. When I apply the brake I can cause it to hold the amperes at some given place, and that means that the car is retarded at a certain rate or pace.

MR. JANNUS: Suppose the car has come to a full stop on the hill, what then?

MR. SPERRY: As I said in the paper, the residual magnetism producing current will hold the car for a time as you can see, and perhaps you did see the last time; this is very much more marked on a large motor than on this one. [Illustrating.] Of course the hand-brake is on the car if you wish to hold it indefinitely.

E. A. MERRILL: About two weeks ago I was in an eastern city where there are a number of grades. They were running two motor cars, pulling three trailers all in one train. Near the top of an eight per cent. grade the fuse blew on one of the motor cars, and the other motor car was not able to hold the train, which started back down hill. Now I would like to ask Mr. Sperry what would be the action of the electric brake in a case like that?

MR. SPERRY: The electric brakes work equally well after the fuse has blown. The blowing of the fuse in the case cited would not have made any difference whatever with the electric brake.

MR. MERRILL: In the case I refer to they caught the train and held it by the ordinary hand-brake. This was an eight per cent. grade, running up to nine per cent. at the top. There were three trailers attached to two motor cars, the two motor cars acting in conjunction. My question is, What would have been the result if they had had your electric brakes and found that they were useless to hold the train?

MR. BRADLEY: The motion of the cars in itself applies this brake.

MR. MERRILL: My point is this. This electric brake will undoubtedly stop the train, but how are you going to hold the train on a grade like that after you have stopped it?

MR. SPERRY: That depends on how long you wish to stop, and has been before explained.

MR. MERRILL: Also, can that brake be used on an ordinary emergency stop? There is a great difference between the emergency stop and the ordinary stop. In an ordinary stop it is of great advantage to have the adhesion increased as the speed decreases; that is, to have the brake pressure decrease. In an emergency stop it is very necessary for that adhesion to remain constant or to increase. Now with the electric brake the stop is very gradual; the retardation is practically uniform. With the hand-brake or with the air brake you can hold the brakes set, and the stop becomes relatively more rapid as the speed decreases.

MR. SPERRY: In reply I would say that it is in emergency service that the full beauty and effectiveness of the electric brake is brought out. By its use the car can be brought almost to rest before the motorman can get the slack out of his hand brake chain. There is nothing more instantaneous than the electric brake. There is no appreciable time lost. You see, the motorman puts it on instantly, and there is no time lost in winding up the slack chain as in hand brake, as stated.

MR. SACHS: I should like to ask another question: What would happen if the motorman suddenly stopped his arc on a down grade, stopping the wheels, so that the motor generated no more current. Would not the retardation case and the car start again? I would like to know whether ethe hand-brake would not then have to be applied, or whether the electric brake would take care of itself?

MR. SPERRY: Such a condition cannot exist. If the wheel stops very little or no current is then circulating in the brake circuit and the wheels start again to roll and the generator to produce the braking current.

MR. SACHS: Under the above condition, if the speed is very low, perhaps the motor would not generate current enough to energize the brake sufficiently, and the car would continue moving down grade slowly.

MR. SPERRY: It is entirely automatic. It will generate and stop itself at very low speed, hardly moving.

MR. SACHS: Is it not possible for the wheels to skid along for a few feet?

MR. SPERRY: No, sir.

MR. SACHS: Then I understand you to say that you cannot hold the car on a down grade with your electric brake alone.

MR. SPERRY: Oh, yes, we can. I illustrated that a few moments ago.

MR. MERRILL: There are a great many statistics showing the space within which a car can be stopped with various brakes. I would like to ask Mr. Sperry if he has any statistics of that sort by which his system can be compared with other systems in use.

MR. SPERRY: The Westinghouse air-brake people from their latest tests give data showing that they only utilized about fourteen per cent. of the available adhesion of the rail, whereas we utilize it nearly up to the limit. I judge from this that with a given speed we could stop in say less than one-fourth of the distance that they require, or did require in the tests named.

COMMUNICATIONS RECEIVED AFTER ADJOURNMENT.

E. A. MERRILL: It is to be regretted that Mr. Sperry has made no tests to determine in what distances cars can be brought to a standstill under given conditions of weight, speed and track, and especially for emergency stops, for this would, in the minds of practical men, go far in determining the merits of the system as compared with other methods; also that we have no definite information as to its ability to control cars on steep grades, as this question is one of the first to arise wherever grades occur. I think Mr. Sperry has failed to make proper allowances, in his comparisons with the Westinghouse tests, for the two principal factors of weight and speed. In stopping the car, a certain amount of energy must be dissipated, and it is evident that there is a limiting weight per ton weight, which cannot be exceeded without hazarding the safety of the car and passengers; it is quite possible not only to reach but to exceed this rate with the Westinghouse air-brake for any speed we meet in street railroad practice; therefore, speed for speed and weight for weight, an electric car cannot safely be stopped in a less distance. The present limit for an 800-ton train from 30 miles per hour is about 325 feet on an emergency application. With a corresponding rate of energy dissipation per ton rate, an allowance of one second for shutting off the current and applying the brakes, the distance required for bringing an 8-ton electric car to a full stop from an initial speed of 12 miles per hour is 39 feet, or a little less than one eighth the former distance. Such a comparison, however, is manifestly unfair, for the 800-ton train can also be stopped in 39 feet under similar conditions, and the 8-ton electric car will require 377 feet for a full stop, from an initial speed of 30 miles per hour; if the rate of energy destruction were greater, of course this distance would be less.

MR. SPERRY: Having noted the above communication, I would add that the tests mentioned in connection with emergency service are given in the general statement. The limiting rate of energy dissipation does not seem to trouble railway managers very much for strictly emergency purposes, and certainly cannot be more severe than reversing the motor under full speed, which is almost a universal practice in cases of the most urgent necessity. The statement that electric cars cannot be safely stopped in less distance than ordinary railway cars I have found not to be true, and probably for the reason that the strain is not required to be transmitted through the swiveling bolt or boltster of the truck high above the wheel contact upon the rail, which has been found to be the first place to give way in emergency stopping in railway service. On the street car the masses are more resiliently supported, especially on the four-wheel car, where the stripping of the car body from the truck is a far more difficult matter than with the swiveling truck. I have found in practice that an emergency stop with the electric brake can be made under the conditions and within practically the distances named in the paper. The easing off of the curve of retardation at both ends, making it an O. G. curve rather than a straight line at a declining angle gives by far the easiest stop. This curve I have found is the one naturally produced by the electric brake, and is probably the condition which yields the sensation of a cushioned stop.

W. E. HARRINGTON: The question of the proper braking of a car should really be viewed from an emergency standpoint, and further, the form or method of braking employed should be such that it be always in use and not known as an emergency brake. The present method of reversing a motor in case of an emergency is absurd, and usually results in opening the magnetic circuit breaker at the power station controlling the particular division the car may be on, or breaking gears and probably springing shafts. The above results are so usual that particular instructions are given to motormen never to reverse, except in cases of extreme emergency, as, for instance, where life is in danger. The recent and established principles of electric railway engineering, which now make it necessary to place magnetic cut-outs on the feeders, leading out from the switchboard of our power stations, has rendered it absolutely necessary to have other methods of stopping our cars without depending on the power station for so doing. An accident occurred recently at York, Pa., where a life was lost, simply because the magnetic cut-outs opened at the power station when the motor circuit was reversed. I

mention this case particularly as it had the rather peculiar effect on the local management of their considering the advisability of going back to the unreliable and station-destroying fuse-wire of ancient history. The facts are so numerous and so convincing that the braking of a car should be self-contained and entirely independent of the power station that it may be considered axiomatic. The above position is further emphasized when we consider the fact that in the next two years it will be as common to see magnetic cut-outs on our cars as it is at present to see such devices in our power stations. I think that the plan and method as employed by Mr. Sperry are correct and practicable, and after

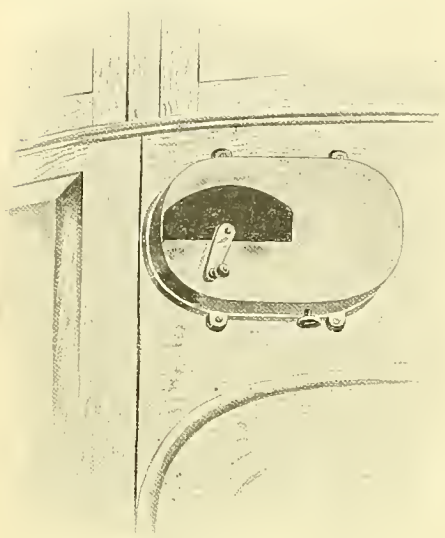

FIG. 1. NON-ARCING AUTOMATIC CAR SWITCH.

a few minor details not insurmountable, are overcome, or rather remedied, the system will be commercially successful.

JOSEPH SACHS: There is one point in reference to the form of electric brake, described by Mr. Sperry, which would appear to be more or less of an objection under certain conditions; that is the fact that it is impossible to completely stop the car for any length of time on a down grade by simply using the electric brake as herein described. During the discussion at the meeting of the Institute I attempted to bring out this point, but it appears to me from the answers made by Mr. Sperry to my questions that I was not properly understood. I assumed a condition where an obstruction made it necessary for the motorman to stop his car instantly and hold it on a down grade, but I could not see how this could be accomplished with the form of brake described. It is true that the car can be brought to a stop by the arrangement Mr. Sperry describes, but I can see no way in which it can be held on a down-grade without the use of some additional device. After the car has been brought to a stop by changing the motor into a dynamo, and throwing it across the brake magnet, the retardation of the brake will also be stopped, as no more current will then be generated by the motor. As a natural consequence, therefore, the car will start again and stop, start again and stop, and so on until it gets to the bottom of the grade, or, perhaps, after the first stop, will run down the grade at perhaps such speed as to prevent enough current being generated by the motor to effect sufficient retardation in the brake to hold it. It would seem there-

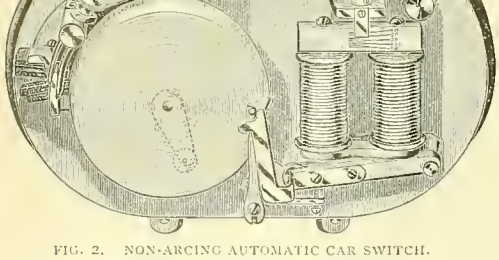

FIG. 2. NON-ARCING AUTOMATIC CAR SWITCH.

fore to me that in case of an accident under the conditions given, that it would become an absolute necessity to provide some means whereby the car can be held any length of time. It is true that this can be accomplished by applying the hand brake after the car has been brought to its first stop, but this would seem to be objectionable. It would seem to be a simple matter to so arrange the brake that current could be supplied to it to hold the car under any conditions. While I think that Mr. Sperry's device is of the greatest interest and value to electric traction, it would seem that the feature which I have described would be an objection, but one which could no doubt readily be obviated, even without the use of the hand-brake.

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The West End company of Boston now runs special cars from certain suburbs into the city Sunday mornings for the convenience of church goers, and advertises these cars in the daily papers. The scheme is proving to be very popular.

## Non-arcing Automatic Car Switch.

In the accompanying cuts is shown the new automatic car cut-out of the Sweet Electric & Manufacturing company of Grand Rapids, Mich. This device, as may be judged from Fig. 1, occupies but little space, being 11 inches long, 8 inches high and 3 inches deep. It is the result of much experiment and is said to be positively non-arcing, as the final break is from carbons, and not from metal contacts. It can be used as an ordinary cut-out, dispensing entirely with the hand cut-out, and as a lightning arrester it is said to be very efficient in action. It is claimed to be an absolute protection to the motors from short-circuits or overload, as the motorman has to use his controller with care, and it prevents his misusing the car motors when in circuit. This switch is designed to take the place of fuse boxes, and for double equipments it can be put in circuit with each motor, so that if a ground or short-circuit occurs it will cut out the defective motor, leaving the good motor still in circuit for operation.

The switch can be placed in any position in the car. Its mechanism is shown in Fig. 2. It is provided with a safety lock, and when set in position cannot be opened by a sudden jar, but remains locked until opened by excessive current or by hand if used as an ordinary cut-out, there being a small push-button on the outside for this purpose. By a small thumb-screw the limit of current it will carry can be adjusted from 25 to 200 amperes. The advantages claimed for a limit switch over ordinary fuse protection is set forth by the company as follows:

It is a well known fact that a fuse is but a frail protection, as its action in fusing is too slow. In nine cases out of ten a fuse will carry ten times its supposed or rated carrying capacity for a few seconds before fusing, allowing this greatly increased current to flow to the point of distribution in field or armatures of the motor. Armatures, too, are often run under defects which are not noticed, and the motorman operates the machine without any apparent knowledge of the fact until his car refuses to move or blows the fuse, and then it is too late for a remedy; the coils have run under a strain of short-circuits until the armature is totally destroyed. With the limit device in circuit you have the best possible protection. Short-circuits frequently occur from dust and grease accumulating on the ring of the commutators, causing at first a slight leakage. The resistance decreases on short-circuit until the substance becomes charred and bridges the commutator segments over the mica insulation between connecting coils in the armature; this causes sparking, which means heating. Under these conditions the insulation on the wires becomes charred and creates a short-circuit, and the current flows across from one coil to its neighboring coil, resulting in the heating of armatures and fields, and finally becoming dangerous.

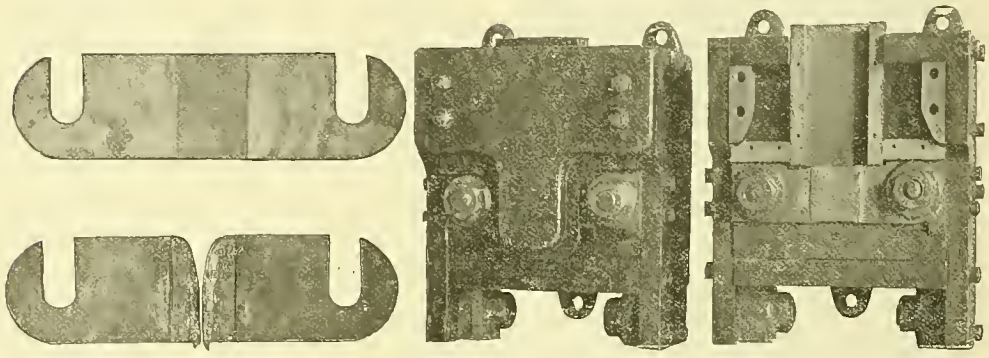


FIG. 1. MAGNETIC BLOW-OUTS. FIG. 2.

## Magnetic Blow-outs.

An interesting experiment was recently made at the Kent avenue station of the Brooklyn City Railroad company to test the efficacy of the magnetic blow-out principle in the fuse carriers which form part of the General Electric company's generator equipments. Previous to the test there had been, on the part of the railroad company, no little scepticism as to the value of the magnetic blow-out, and the test was made with the view primarily of proving the correctness of the claims of the manufacturing company—that the apparatus would cope with almost any demand made upon it.

The test was made on the railway company's dock behind the station under the supervision of Walter A. Pearson, superintendent. Six water rheostats of large capacity were connected into the circuit in series in order to regulate the load, and the conductors were brought directly from two of the four 1,500 kilowatt multipolar generators. The fuse blew at 4,400 amperes at 550 volts, an equivalent of 3,243 horse power. The result of the test was a complete demonstration of the efficacy of the magnetic blow-out on a very powerful and destructive arc. Fig. 1 shows the blown fuse and one of similar capacity intact. It will be seen that the action of the magnetic blow-out must have been instantaneous, and perhaps the most remarkable feature is the small amount of metal blown.

The magnetic blow-out principle is a special characteristic of all apparatus manufactured by the General Electric company which has to deal with possible arcs. It is successfully embodied in the well-known "K" car controller, as well as is the lightning arresters, fuse-boxes, etc. It is claimed to be the only known method of preventing destructive arcing, and is protected by patents. The fuse box in which the fuse shown in the cut was blown was exhibited at the Atlanta convention and served to convince many who had doubted the efficacy of the magnetic blow-out principle. It is shown before and after the test in Fig. 2.

## Electrical Contractors' Meeting.

A score or more of the leading electrical contractors of Chicago, together with several representatives of the supply trade, met Monday evening, November 12th, at the Grand Pacific Hotel. It is the object of the projectors of the new organization to protect the interests of the dealer and the contractor. At the meeting on Monday night it was agreed that the necessity of good electrical work was made more apparent every day by the active interest shown by the insurance companies. It is claimed that the contractors' field is full of irresponsible men, without financial resources or ability to handle or bid upon work; that there is a continual mushroom growth in the electrical business fostered by the mistaken idea that the apparent low prices quoted by bidders on work are an evidence that work can be done for those prices, while in reality the work costs more; that with the failure of these contractors the supply man loses and the legitimate contractor suffers from unjust and unfair competition.

It is with the purpose of educating the purchasing public to the correct view of the matter in hand that the contractors are looking to co-operation. It means the maintenance of a market for the better grades of work and a decrease in the credit risks.

## Connecticut State Street Railway Association.

The annual meeting of the Connecticut State Street Railway association will be held at New Haven, Conn., November 21st. The officers of the association are: President, H. H. Wood, Derby; vice-president, H. S. Parmelee, New Haven; secretary, R. A. Fosdick, Stamford; treasurer, E. S. Goodrich, Hartford; executive commitee, A. M. Young, Waterbury; G. A. W. Dodge and I. A. Kelsey, New Haven.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, November 10.—The assertion by some physicians and electrical men that only apparent death results from the shock in the electrical executions in this state is again exciting considerable attention. The almost incredible statement is made that the current and voltage are not sufficient to totally extinguish the spark of life, and that death is really caused by the knives of the surgeons making the autopsy. Governor Flower has been asked to allow the next man condemned to death to be used as a subject of experiment in resuscitation after undergoing the penalty of electrical execution as practiced in the state prisons. To the Associated Press representative he made this statement, when his attention was called to the printed allegations that certain physicians would ask for such permission: "I am perfectly willing to allow the experiment to be made if it is within my power under the law. I think it would be a good thing to have this long-standing controversy settled at once and forever." The attempt, if made, will undoubtedly create intense interest in the scientific world. It will also arouse curiosity among laymen, because, if successful, it will bring to life a new man who cannot be executed, having once suffered the penalty of death.

Electric rail welding is being tried in Brooklyn by the Nassua Electric Railroad company. The work, which is in charge of the Johnson company of Johnstown, Pa., was

somewhat delayed by the insufficient voltage at first used in welding. The company received current of 500 volts from the Atlantic avenue trolley line. It later erected a temporary power plant of its own and is now using 600 volts.

Telegraph communication has been cut off repeatedly during the last year on account of the severe storms along the coast. The storm which swept over this city last Monday night, and became so severe in New England, has greatly crippled for the time the service of the Western Union Telegraph company. Instead of the many lines of communication between this city and Boston there were only three available. The greatest damage has been done in Massachusetts, Rhode Island, and in some parts of Connecticut. Between Boston and Springfield, Hartford and New Haven, and north and south of Providence poles and wires were overthrown, and broken in large numbers, and for a time communication was entirely cut off.

The Bankers & Merchants' Telegraph company litigation claimed the attention of Judge Beach, in the Supreme Court this week, when the case of John Anderson against the United Lines Telegraph company and John W. Mackay and others came up. It was alleged that the contract made with the reorganization committee was not properly carried out; that the property of the United Lines Telegraph company was taken without consideration, and that the second mortgage bondholders had been defrauded. Judge Beach dismissed the suit after hearing argument, and a motion was at once made by the plaintiff for leave to amend his complaint. This motion was also denied, on the grounds that the plaintiff had waited seven years before beginning this suit and that the present suit had also been pending for two years. Judge Beach also decided that there had been no breach of contract and that nobody had been defrauded.

To the electrical man the most interesting result of Tuesday's election in New York, from a commercial point of view, was the overwhelming vote in favor of municipal construction of a rapid transit system. In view of this decision the following clause from the act submitting the question to the voters becomes important:

Section 13. In case the majority of votes cast at such election shall be in favor of such municipal construction of said railway or railways, it shall be the duty of said Board of Rapid Transit Railway Commissioners within thirty days after the official declaration of the said vote, to proceed to construct the said railway or railways, and to make and let all contracts required for the performance of the work necessary to be done and performed in and about the construction thereof. All such contracts must, before execution, be approved as to form by the counsel to the corporation or other chief legal adviser for said city.

This is not construed to mean that actual construction work must be under way within thirty days from the date of the official canvass, but that the task of selecting the final route and making the working plans must be actually entered upon. "The contracts, which would be considered part of the construction, must be studied with great care," says Henry R. Beekman, one of the counsel for the commission.

"While under the amended Rapid Transit act the board is called upon to consider only the plans of its predecessor," says the *Herald*, "and is not bound to adopt any particular route or system, it is now pretty well assured that the west side line will conform in its main features to the underground route laid out by the old commission. This follows the line of Broadway to Fifty-ninth street, and thence up the Boulevard, Eleventh avenue and the Kingsbridge road to the northern boundary of the city. In addition to this, the engineers have laid out an east side line, the details of which have not yet been published. It will thus be seen that a vast amount of preliminary work has already been accomplished."

A meeting of the commission was held yesterday afternoon. After the president had announced that the board was reconvened under the authority of the resolution adopted at the last session, the commissioners entered into a discussion of the old routes and the advisability of making certain changes, and also of the line of the proposed east side route, north of Forty-second street. The conference, in which all the members present took part, lasted for nearly two hours, and, except in regard to some minor details, there was a most gratifying unanimity of opinion. No definite action was, however, taken, and it was decided that for the present the details of the proposed east side route should not be made public.

The following resolution was offered and unanimously adopted.

*Resolved*, That public hearings he given on Tuesday and Wednesday, November 13th and 14th, from half-past one to half-past four P. M., at which persons will be heard who desire to suggest changes in routes already provisionally adopted by this board, and to make suggestions as to the extension of the east side route above the Grand Central station.

The board will receive suggestions as to the route only, and not as to the plans of construction.

One of the important reforms secured by the voters' acceptance of the new state constitution is that forbidding the issue of passes and franks by railroad, telegraph or telephone companies to public officers, for which the offending official "shall be deemed guilty of a misdemeanor and shall forfeit his office at suit of the attorney-general." The amendment prohibiting pool-selling and book-making at horse races will, it is thought, deprive the Western Union company of a large revenue from racing sources. W. F. O.

## PERSONAL.

S. G. Weiler, formerly assistant electrical engineer of the World's Fair, is now a member of the technical staff of Pierce & Richardson, Chicago.

William S. Monroe, who was connected with the mechanical engineering department of the World's Fair last year, has opened an office as a mechanical and electrical engineer in the Rookery, Chicago.

James M. McClave, representing the Diamond Incandescent Lamp company, Denver, Colo., visited Chicago last week. Mr. McClave has just returned from a combined business and pleasure trip throughout the South, and he visited Chicago en route to Denver.

## TRADE NEWS.

The Washington Electric company, Chicago, is putting on the market some very fine annunciators.

The Partrick & Carter company, Philadelphia, is the sole selling agent for the Applegate electric matting. This matting will hereafter be made in three standard widths: two, two and a half and three feet. Each roll will be about 50 feet long.

Cameron & Gillett of Detroit have the contract for placing a complete electric light plant in the new building of the Detroiter Socialer Turnverein. The plant will comprise an installation for 362 16 candle power incandescent lamps, with fixtures complete, and also a searchlight for stage effects, together with dimmer and other appliances for this purpose. The same firm has the contract for the construction work for Church & Co., Soda Ash Works, Trenton, Wayne county, Mich., and also for the construction of a 130 light plant for Leiland, Faulkner & Norton company, Detroit.

M. B. Austin, formerly with the Knapp Electrical Works, has opened an office at 1533 Monadnock building, Chicago, as general western agent of the Safety Insulated Wire & Cable company of New York and Holmes, Booth & Haydens of Waterbury, Conn. Mr. Austin's warerooms are at 271 and 273 Franklin street.

From every side reports are coming in to the effect that business prospects for the coming winter are bright. Among the firms who feel highly encouraged over the outlook is the Royal Electric company of Peoria, Ill. Manager G. G. Luthy writes that sales for the Royal transformer for this month already amount to 5,000 lights capacity. As is well known, the Royal Electric company is one of Peoria's most prosperous concerns and has achieved its high reputation in the electrical trade through its exploiture of a remarkable type of dynamo. The company of late has been paying special attention to pushing its transformer, and the large orders of this month attest to the merits of the company's product in this line. Manager Luthy deserves no little credit for the present prosperous condition of his company's affairs.

## BUSINESS.

The fine new Chamber of Commerce building in Detroit will be wired with Simplex wire.

Grier Bros. are in receipt of some very favorable letters in regard to the Bryant chandelier switch, which they are introducing in the West.

Lee & Collins report some fine recent sales of their Favorite tape and L. C. splicing compound at their new location, 239 La Salle street, Chicago.

The Sperry Electric Railway company has just issued a new and handsomely illustrated catalogue. It shows the single motor equipment, in which the driving wheels are all coupled and revolve in unison, thus affording, it is claimed, greater efficiency than where a separate motor is coupled to each axle. Tests showing great efficiency in hill climbing are given, and the Sperry electric brake is also described.

The Electric Appliance company is celebrating the fact that it is just about entering upon its fourth business year, and it finds additional reason for being joyful in the fact that it is experiencing a fine run of business and enjoying exceptional prosperity. The electric railway trade is beginning to appreciate the fact that the "Lynn" electric railway appliances are a very desirable line, and is showing that appreciation by placing orders for overhead line material with the Electric Appliance company, the western selling agent for these specialties.

Holtz, Fey & Bloomer of San Francisco have removed their factory to No. 630 Mission street, where they have also opened a store for a general electrical supply business. They will give quotations on any kind of electrical work, material and manufacturing. Special attention is given to the manufacture of medical batteries and physicians' cabinets, gear cutting, instruments and model work. Theo. F. Holtz was for ten years superintendent of the factory, and Chas. Fey was connected with the electro mechanical department, of the California Electrical Works. The latter has had an extensive experience in the best of European and American establishments. J. G. Bloomer, late manager of the California Electrical Works, has also joined the firm.

For the preservation of metals used in roofs, bridges and construction work, painting with pure linseed oil and oxide of lead or graphite paints is recommended. In comparing the two paints it may be well to add that a properly made graphite paint should prove more durable and a better protector than oxide of lead. Graphite has a strong affinity for metal surfaces, and experienced painters claim that even where light colors are desirable, graphite paint should be used as a priming coat. Again, graphite is impervious to the action of heat, cold, sea air, acid or alkali fumes, which are more or less destructive agents to lead paints. The Joseph Dixon Crucible company, Jersey City, N. J., has manufactured a pure linseed oil and graphite paint for over 25 years, and has some very convincing testimonials of its value.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued October 30, 1894.*

528,390. Mechanical Telephone. Jerome Prince, Milford, Mass. Application filed May 16, 1894.

The object of this invention is to provide improved means for transmitting human speech and other sounds, and to render the sounds so transmitted more audible and the tones of the voice more natural. Another object is to combine with an acoustic telephone an inclosed magnet, having one pole connected to the transmitting wire and the other with the ground. A characteristic feature is a series of resonant tubes within the shell, varying in length and corresponding in tones to the notes of the musical scale. For this purpose short glass tubes held fast by one end are used. The harmonic vibrations due to these open tubes give a more natural and distinct tone to the voice and facilitate its transmission.

*Issued November 6, 1894.*

528,529. Plug for Establishing Electrical Connections. Charles W. Brown, Montreal, Canada. Application filed January 16, 1894.

A plug for establishing electrical connections having a body portion tubular in cross-section adapted to be inserted in a correspondingly shaped socket and having one or more integral flexible expanders, projecting normally beyond the periphery of the tubular body portion.

528,539. Rheostat. John C. Fyfe, Chicago, Ill. Application filed April 27, 1894.

This invention relates to a method of ventilating and insulating layers of electrical conductors consisting in separating the layers with silicate of soda and then subjecting them to heat sufficient to crystalize the silicate.

528,547. Electrically Operated Elevator. Elias Marshall, Boston, Mass. Application filed January 20, 1894.

An electrically operated elevator mechanism having top and bottom switches placed in the elevator well, and a current reversing switch adapted to be operated from the car.

528,561. Trolley Wire Clip. James W. Perry, Philadelphia, Pa. Application filed May 5, 1894.

A trolley wire clip having a body consisting of a screw socket and elongated web with a curved recess forming a portion of the wall of the wire pocket, the ends of the curved portion of the web only being bent around to pass under and up the opposite side, so as to support the wire without the aid of the clamp plate, and a clamp plate having a curved recess forming the other portion of the wall of the wire pocket, holding the wire in the pocket, and fastenings for holding the body and the clamp plate together.

528,564. Electrical Retoucher. Charles M. Savage, Warren, Pa. Application filed March 17, 1894.

This invention consists of an electrical retoucher for negatives, the illustration showing the combination of the electromagnet *B*, armature *C*, rod *G*, secured to said armature, and having an aperture *g* near its free end, and adapted to telescope within a hollow shaft *J*, having a pin *I* secured in an aperture near its upper end, its free end adapted to engage a stippling point, a coiled spring *K* bearing against a shoulder *k* and the under side of the pin, and another coiled spring *H* bearing against a shoulder *h* and the upper side of the pin, a stippling motion being imparted to the point by means of a succession of blows delivered on the pin by the upper edge of the slot *g*.

528,566. Combined Municipal Telegraph and Telephone System. Harry M. Seitzinger, Wilkesbarre, Pa. Application filed May 28, 1894.

A combined telegraph and telephone system consisting of the central station, main line, battery for said line and switch at the central station for cutting out said battery, of sub-stations, each provided with a telegraph or signal instrument and a telephone upon separate circuits, a switch arranged to connect the main line with either of said circuits, a magnet in the signal instrument circuit, an operating lever for said instrument and a locking lever for said operating lever, said locking lever being operated by the magnet and arranged to be disengaged from the operating lever when the instrument circuit is connected with the main line and the battery, and engaged with said lever when the battery is cut out or the instrument circuit disconnected from the main line.

528,586. Apparatus for Electro-deposition. Henry L. Bridgman, Blue Island, Ill. Application filed October 3, 1893.

Electro-depositing apparatus comprising a vat for the electrolytic fluid in which the anodes are suspended, a rotatable insulated shaft and a cathode secured to it so as to rotate with it, said cathode being of general plate form, with a spiral groove formed on at least one side, with insulating material and a generator connected with the cathode, through the shaft and the anodes.

528,587. Apparatus for Electro-deposition. Henry L. Bridgman, Blue Island, Ill. Application filed October 3, 1893.

Electric-depositing apparatus comprising an insulated shaft supported in the electrolytic cell and a cathode formed in sections separably supported on the shaft in relative positions to afford an intervening space for forming the mold to receive the deposits of metal.

528,589. Electric Burglar Alarm. Wilmot A. Brownell, Boston, Mass., and James B. Seager, Hancock, Mich. Application filed January 31, 1894.

This invention relates to the combination with a door, lid, or drawer, of an electric circuit, an alarm, and two pairs or sets of circuit closers or contacts all being in series in said circuit when in connection, one pair of contacts being in the lock and adapted to be connected by the bolt when extended or by a separate conductor, and the contacts of the other pair being respectively on the door and door frame, and adapted to be connected when the door is open or ajar.

528,590. Telephone Exchange System. Wallace Childs, Fort Smith, Ark. Original application filed May 27, 1890. Divided and this application filed May 12, 1891.

An automatically operated telegraphic or telephonic exchange switchboard, comprising a series of contact points arranged in concentric circles and a relatively moving switch contact adapted to co-operate with said contact points.

528,591. Telegraphic and Telephonic Exchange System. Wallace Childs, Fort Smith, Ark. Application filed May 27, 1890.

A system of telegraphic or telephonic exchange having independent transmitters and receivers connected in open circuits converging in a central office and terminating in switch paths, an arm, in electrical connection with each of said circuits and provided with a switch which has an electrode-roller and wheels and one superimposed upon the other for supporting and operating said roller over a spiral grooved pathway, and electro-magnetic propelling devices therefor in a line from one of the local stations whereby said roller may be moved into connection with each of circuits terminating in the said spiral grooved pathways.

528,592. Telephony. Frank R. Colvin, New York, N. Y. Application filed July 26, 1894.

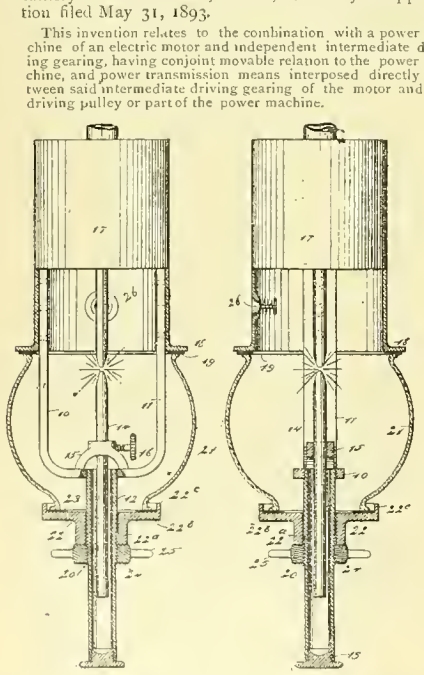
Relates to a system of telephonic intercommunication, comprising a plurality of stations connected in multiple-arc relation to the line, each station being provided with a high potential calling generator and a talking outfit organized to impose on line low potential talking currents.

528,593. Railway Signaling System. Murray Corrington, New York, N. Y. Application filed December 3, 1891.

A railway signaling system, combining a signal comprising a spaced dial and a visual index moving by advance or by retrograde steps over the intervals of said dial, an electric contact-switch, which is held in one position when the index of said dial is at its zero point, but in another position at all other points in the revolution of said index, and an illuminating device which is energized by an electric current whenever said switch is in any other than the normal or zero position whereby said visual signal is illuminated whenever its index is out of the position of zero.

528,608. Utilizing Electric Motors for Operating Machinery. Ernst Richter, Berlin, Germany. Application filed May 31, 1893.

This invention relates to the combination with a power machine of an electric motor and independent intermediate driving gearing, having conjoint movable relation to the power machine, and power transmission means interposed directly between said intermediate driving gearing of the motor and the driving pulley or part of the power machine.



NO. 528,642.

528,615. Switch Operating Mechanism for Hoisting Machinery. Alton J. Shaw, Muskegon, Mich. Application filed June 7, 1894.

This device consists of two independent electric switches, an operating lever common to both, and adapted to move both together and either one alone.

528,620. Electric Hoisting Machinery. Alton J. Shaw, Muskegon, Mich. Application filed June 25, 1894.

This invention relates to electric hoisting machinery provided with magnetic brake for controlling the same, a stop or detent to limit the action of the brake, and an electro-magnet included in circuit with the hoisting motor and serving to control the position of the stop or detent.

528,635. Magnet. Adrian H. Hoyt, Penacook, N. H. Application filed March 14, 1894.

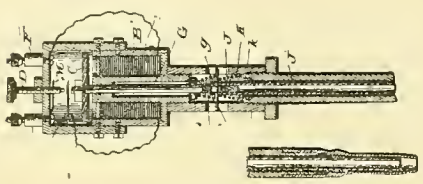
A permanent magnet composed of a bar of steel provided with a substantially circular opening and having its magnetic poles at opposite sides of and substantially surrounding said opening.

528,642. Electric Arc Lamp. Alfred H. Moses, Jr., New York, N. Y. Application filed January 8, 1894.

The invention consists of an electric arc lamp in combination with the following: a pendent of the frame provided with a stop at one end and an exteriorly threaded section, the surface of the pendant being plain between the thread and stop, of a casing attached to the frame and provided with a flanged lower edge, a support having sliding movement upon the pendant of the frame, a globe located upon the support and adapted for engagement with the flange of the casing, and a lock nut located upon the pendant and engaging with the support, whereby the support and lock nut may be moved together and a light joint may be obtained between the globe and support and the globe and the casing.

528,647. Storage Battery. Charles J. Reed, Philadelphia, Pa. Application filed June 5, 1894.

As in the cut, a positive storage battery electrode surrounded by a protecting envelope consisting of a sheet of perforated material, having an interior coating of fibrous material, said envelope and coating being not readily attacked by the battery liquid, in combination with a negative electrode consisting of vertically disposed strips located on the opposite edges of the positive electrode and its surrounding envelope, and held in place by a strip of like material wound around the entire mass and having its ends secured.



NO. 528,564.

528,648. Storage Battery. Charles J. Reed, Philadelphia, Pa. Application filed June 8, 1894.

An accumulator or storage battery having its electrodes immersed in a solution of sulphuric acid and cadmium sulphate.

528,669. Galvanic Battery. Mortimer M. Hayden, New York, N. Y. Application filed February 21, 1894.

A galvanic battery provided with a cover and with a porous cup provided with internal screw threads at the top and a screw threaded flanged plug, whereby said cover is clamped between said cup and said flanged plug.

528,672. Circuit Closer. Henry J. Hovey, Oak Park, Ill. Application filed December 26, 1893.

A circuit closer for railway signals, having in combination the electric contacts of terminals, a fluid compressor or pump having independently movable plungers adapted to effect the compression of the fluid therein, and means for closing said contacts together by the fluid pressure from said compressor or pump.

528,678. Electric Alarm Clock. Michael McDonnell, New Bedford, Mass. Application filed May 29, 1894.

An electric alarm clock provided with adjustable contact devices consisting of the metallic posts, having an arm bearing in its outer extremity a flat spring adapted to yield to the slight pressure of the hand of the clock in whose path it is adjusted.

528,684. Electric Arc Lamp. Charles E. Ongley, New York, N. Y. Application filed February 17, 1894.

The invention pertains to an arc lamp, in combination with pivoted arms, adapted to carry carbons, a screw-threaded shaft, nuts moved thereby, and operatively connected respectively to said arms so as to move them oppositely to feed the carbons, a shunt coil and means operated thereby for turning the screw shaft to move the arms and carbons toward each other.

528,685. Trolley Catcher. Albert S. Osborn, Rochester, N. Y. Application filed May 9, 1894.

The invention comprises the combination, with the trolley arm and its operating cord, of a spring-operated shaft, a winding head, a fixed ratchet a spring-operated detent which engages with the ratchet, a cord-holder arranged opposite the winding head whereby the cord can wind on the winding head, said cord-holder being pivoted to the shaft, and a connection extending from the cord-holder to the detent, whereby when the cord-holder is raised, the detent is drawn back and disengaged from the ratchet.

528,740. Secondary Battery. Elias M. Poston, Springfield, O. Application filed January 29, 1894.

A secondary battery, having an outer casing formed in sections, each of said sections being provided with internally projecting lugs or shoulders, non-conducting porous plates adapted to rest against said shoulders, and a peripheral opening extending through the outer walls of said casing between said porous plates, positive and negative electrodes arranged at and adapted to close the ends of the respective sections, active material between said porous plates and electrodes, and an electrolytic fluid within said casing.

528,744. Insulating Compound. Oscar Stiles, Omaha, Neb. Application filed March 26, 1894.

An insulating compound comprising the combination of the following ingredients: asbestos, alcohol, shellac and mica.

528,767. Trolley Line Breaker. Charles H. Dey and Johan M. Anderson, Boston, Mass. Application filed February 16, 1894.

In a trolley line breaker or insulating joint the combination with line terminals of a double insulation separating the said terminals and a non-conductor interposed between the said terminals and with which the trolley wheel engages when passing from one terminal to another and auxiliary removable terminals co-operating with the line terminals for the purpose specified.

528,778. Electrical Transformer. Rudolph M. Hunter, Philadelphia, Pa. Application filed April 6, 1894.

An electrical converter having its coils hermetically sealed within a lead case and having a powdered moisture absorbent contained within the lead case.

528,788. Bond for Electric Railways. Henry B. Nichols and Frederick H. Lincoln, Philadelphia, Pa. Application filed September 20, 1894.

A bonding joint or connection for electric railways, comprising a rail provided with an opening, a bonding wire, nuts engaging therewith and provided with flanges engaging the opening of said rail, one of said nuts provided with a pour-hole to permit of molten metallic material being introduced into the same so as to expand and establish an air and water-tight connection of the rail with said bonding wire.

528,867. Automatic Railway Switch. Charles F. Duval, Boston, Mass. Application filed November 25, 1893.

The invention comprises in a railway switch apparatus, the combination of a movable switch-point, a push-piece arranged for actuation by a passing car, operating connections between said push-piece and the switch-point with provisions for turning said point in either direction and including an adjustable member whose position determines the direction of movement of the switch-point under impulse of the push-piece, and electrical devices for establishing two different positions of the said adjustable member.

528,870. Apparatus for Measuring Electricity. William Friese-Greene, London, England. Application filed March 28, 1894.

An apparatus for measuring electricity consisting of the combination of a solenoid in the main circuit, a fixed rod and a movable rod paralled with the axis of said solenoid, said movable rod being adapted to be repulsed by said fixed rod, a curved arm connected to said movable rod, a solenoid provided with a plunger, mechanism for operating said plunger and a bar sliding on said curved arm and operated by said plunger for registering the current.

528,881. Electric Leak Alarm. Charles C. Kahne, Andrew A. Adkins, Winfield S. Peirce, John E. Martin and George F. Kahne, Ashland, Ky. Application filed July 6, 1894.

The device comprises in an electric leak alarm the combination of a box having a movable cover, a float working in said box a contact plate attached to said cover above the float and an upwardly projecting contact post carried by the float and adapted to be raised against the plate, said plate and contact post being connected with the respective terminals of an alarm circuit.

528,893. Rheostat. Alton J. Shaw, Muskegon, Mich. Application filed April 10, 1894.

A resistance device consisting of a band or ribbon of conducting material, crimped or folded facewise, and then coiled edgewise.

528,894. Rheostat. Alton J. Shaw, Muskegon, Mich. Application filed April 10, 1894.

A rheostat consisting of a series of blocks provided with lateral contact plates, a series of folded conducting strips interposed between the blocks and connected therewith in series, and a movable contact adapted and arranged to sweep the contact plates.

528,898. Railway Electric Switch. Walter V. Ash and Joseph H. Ash, Newark, N. J. Application filed July 5, 1894.

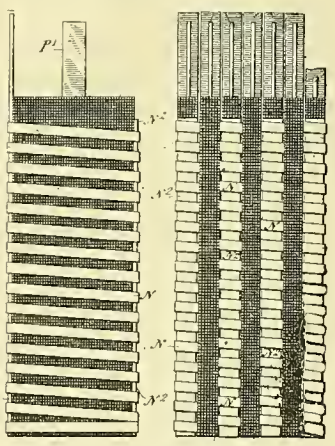
The device comprises the combination in a railway of a vibrating switch point, a pivoted armature lever fixed to said switch point an electro-magnet acting upon said armature lever a trigger adapted to lock the same in one position, a cord connected with said trigger and extending to a distant point in the rails, a thrust rod projecting above the rails through an opening therein and adapted to be moved downward by the wheels of the vehicles running upon said rails and thereby moving the trigger and releasing the armature lever.

528,900. Electric Switch Frank G. Bolles, Washington, D. C. Application filed March 27, 1894.

A switch for controlling electric circuits, having a fixed contact and a movable contact, an operating handle on the movable contact, and movable relatively thereto, and a clamping device operated by an independent movement of said handle for tightening the contact between the fixed and movable contacts after the circuits are closed.

528,902. Means for Multiplex Telegraphing Between Cars of Railways. Aaron Frver, Bath-on-the-Hudson, N. Y. Application filed March 17, 1892.

The invention consists of the combination with a line wire supported parallel with the track of a railway, and relatively at a side of the same, and a car, of a pivoted trolley arm, horizontal spindle trolley wheel loosely mounted on said spindle, tension spring between said trolley arm and the car, and a wire for connection at will of the said spindle with an apparatus operated by electrical currents.



NO. 528,647.

528,907. Rheostat and Heater. Robert C. Mitchell, New York, N. Y. Application filed January 17, 1894.

The device comprises the combination in a heater of a metal base, a resistance wire with perforated sheet or sheets of non-fusible insulation interposed between the base and wire, with a covering of insulating substance.

528,911. Coin-operated Electric Apparatus. John H. Elfering, Cincinnati, O. Application filed August 30, 1889.

The invention consists in a coin-controlled electric device, of handles and levers connected thereto, a transverse bar connecting said levers, a coin receptacle attached to the bar and having a transveree notch, a sliding bolt which when the coin receptacle is empty engages said notch when one attempts to raise the levers, the coin receptacle being provided with a vertical slit or receptacle intersecting said notch, for enabling a part of the periphery of the coin to fill said notch so far as the bolt is concerned, and coin passage way leading from the exterior of the case to the coin receptacle.

# Western Electrician.

EVERY SATURDAY.

Vol XV. CHICAGO, NOVEMBER 24, 1894. No. 21.


## Calumet Gas Company's Arc Lighting Station.

Probably no central station plant in Chicago serves a more widely extended territory than that of the Calumet Gas company in South Chicago. From its station at Eric avenue and Ninety-sixth street the company distributes current as far north as Thirty-first street, on the Illinois Central tracks, and as far south as the racetrack at Roby, just over the state line of Indiana. These two points are about twelve miles apart, while on the west the circuits extend to Washington Heights. An important feature of the company's business is the lighting of the Illinois Central Railroad company's tracks, and this is done from West Pullman to Thirty-first street, a distance of eight miles, illumination being provided both above the tracks and in the subways under the elevated structure extending from Forty-third to Sixty-seventh streets. The commercial and street lighting service does not, however, extend north of Thirty-ninth street, but reaches Roby and West Pullman on the south. The southern portion of this wide area is not thickly settled and is mainly given over to manufacturing enterprises and the homes of the workmen. The demand, therefore, for electric lighting is almost entirely for arcs for street illumination, railway crossings and factory use, and none but arc machines are used to supply the current. Owing to the widely scattered points of consumption, the company is obliged to operate circuits of unusual length. The average length of its eleven circuits is twelve miles, while the longest circuit covers a distance of thirty miles in its tortuous course. During the World's Fair one circuit 42 miles long was operated from this station. The company's record in operating long circuits is probably unique. The potential used is from 3,500 to 4,000 volts.

The plant has been in existence for several years, but the present owners have been in possession but two years, and have entirely remodeled the equipment in that time and have other improvements and additions in contemplation, as the business has shown a steady and quite remarkable growth. As may be judged from the corporate name, the company is engaged in manufacturing gas as well as in generating electricity, and an exterior view of the works at Ninety-sixth street, in which both operations are carried on, is shown in Fig. 2. An interior view of the dynamo room is given in Fig. 1. James Walsh is the president of the company; Lyman A. Walton, secretary and treasurer; F. K. Lane, superintendent of gas department, and W. B. McDonald, superintendent of electric department.

The boiler plant consists of five horizontal tubular boilers, made by John Mohr & Son of Chicago. The aggregate capacity is about 600 horse power. Two stacks—one of iron and the other of brick—furnish draught for the furnaces, the second stack having been made necessary by extensions to the plant. West Virginia bituminous coal is used, with very satisfying results. The average daily consumption is less than 24,000 pounds, and from this 150,000 cubic feet of gas is made and 750 arc lamps, about equally divided into 1,200 candle power and 2,000 candle power classes, are operated. It should be explained that, as the water and oil process is used, no coal is used directly for making gas, steam being supplied to the retorts, and also that, owing to losses in line transmission, the 750 lamps actually burned are equivalent to 820 lamps in current-consuming capacity.

In the engine and dynamo room, Fig. 1, power is supplied by two horizontal slow-speed Reynolds-Corliss engines belted to either end of a line shaft in the center of the room. These engines have single cylinders and are rated at 250 and 500 horse power respectively, the larger being shown in the illustration. The shafting is supplied with Eclipse and Dodge friction clutch pulleys, and to it are belted, usually in tandem, eleven Wood arc dynamos. Six of these machines have each a capacity of 75 1,200 candle power lamps and the remaining five are 80 lighters, designed for lamps of 2,000 candle power. The engines are driven at 80 revolutions per minute, the line shaft at 320 and the dynamo pulleys at from 850 to 875.

The eleven circuits range from 57 to 78 lamps each. The line construction is of the ordinary overhead type, with No. 6 wire. About 50 Bernstein series incandescent lamps are wired on the arc circuits in the places of business of South Chicago customers. The station switchboard is of wood, but is about to be replaced by one of marble. Wood and Thomson-Houston arc lamps are used mainly, the 2,000 candle power lamps taking 9.6 amperes and the 1,200 lamps 6.8 amperes. Voltmeter readings are taken half-hourly, and the plant, as a whole, is efficient and well kept up.

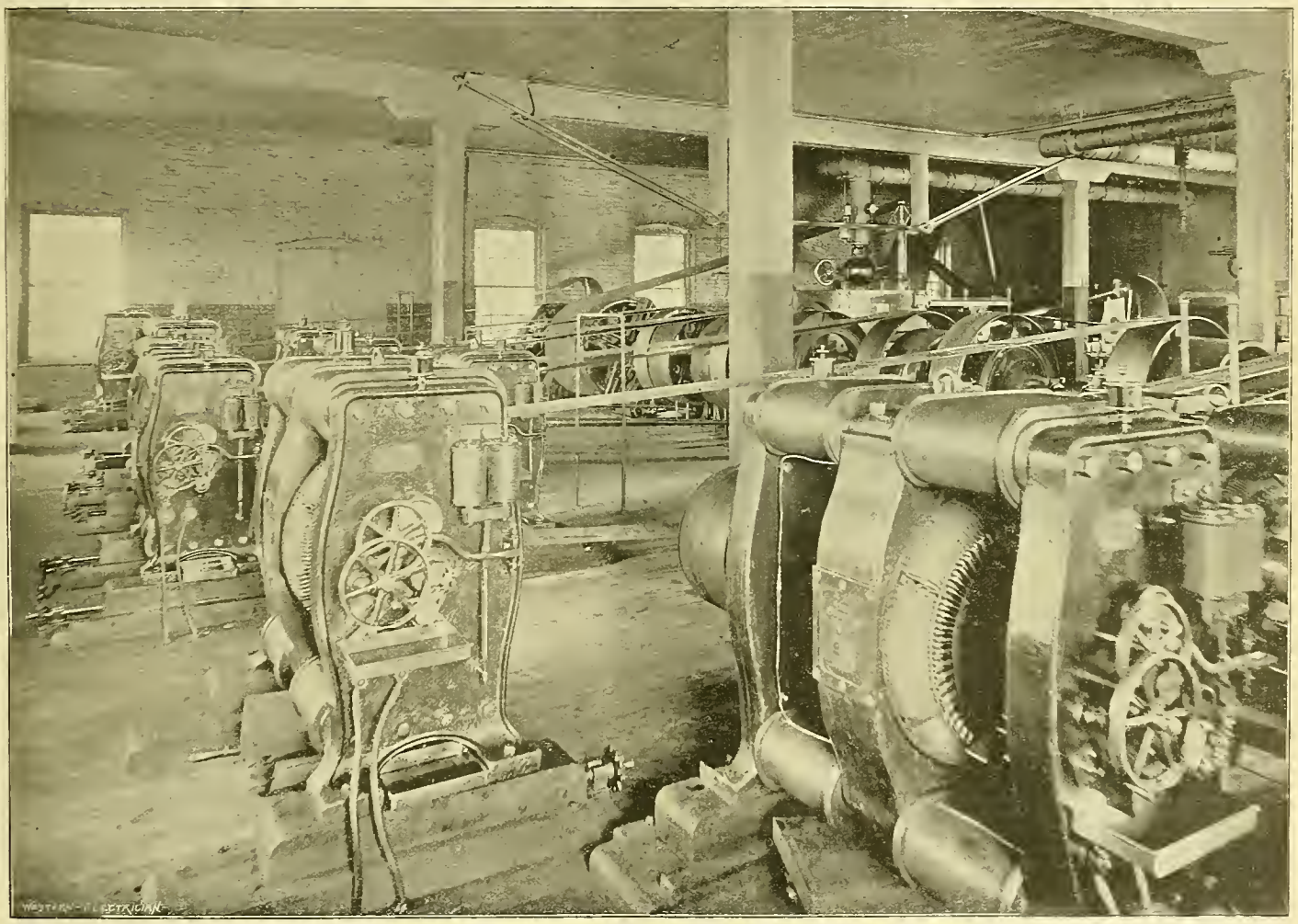


FIG. 1. CALUMET GAS COMPANY'S ARC LIGHTING STATION.—ENGINE AND DYNAMO ROOM.

## Telephones for Government Use.

The secretary of the Department of the Interior has called for bids for a complete telephone exchange system for the Interior Department building, the Pension Office building and the Geological Survey. The proposals will be received and opened on December 18th.

Service has been resumed on the Northeast Street Railway company's line in Kansas City. The insurance on the $20,000 loss on the car house by the recent fire at St. John and Carey avenues is being adjusted. The loss of service was a very serious inconvenience to the northeast part of the city.

## Electricity on Shipboard: Its Present Position and Future Development.[1]

By S. Dana Greene.

I.

PRESENT POSITION.

When the enormous increase in the practical applications of electricity on land, during the last ten years, is compared with what has been done in the same direction and during the same period on shipboard, one is inclined, at first thought, to conclude that the naval architect and engineer are behind their professional brethren on shore in appreciating and utilizing a new and exceedingly flexible form of energy.

During the period named immense central stations have grown up in every town and city of the land, filling the streets with their ever extending feeders and mains, and supplying light, power and heat to thousands of consumers. The horse railroad has become a back number, and in its place we see the electric trolley car; while in the largest cities the electric underground and storage battery cars are proving their reliability and sounding the death knell of the cable. Enormous water powers, hitherto inaccessible or undeveloped, have been harnessed to the electric dynamo, and their power transmitted over distances and through territory previously impassible, to industrial centers, where business and enterprise have had opened to them new channels of activity and profit. The telephone and telegraph have covered the continent with their network of connections and practically annihilated space. Last, but by no means least, capital has been attracted by this new and flexible agency, electricity, and money has not been lacking to continue the marvelous work of development on lines and in directions of still greater magnitude and with greater practical results. Europe has led in the evolution of some branches of the science of electricity, as it has before led in other sciences, but in practical demonstrations and applications America is undoubtedly in the lead, and from present indications will remain there. This is due partly to the resources at our command, but principally because of the practical nature and the well-known ingenuity and boldness of the American engineer in applying scientific principles to practical problems, in new ways and with new agencies.

FIG. 2. CALUMET GAS COMPANY'S ARC LIGHTING STATION.—EXTERIOR OF WORKS.

On shipboard electricity has at last been recognized as the proper agency for lighting, and apparatus and methods of installation have been so improved and standardized that the electric ship plant can now be relied upon for continuous and economical service. Beyond this, it cannot be said that electricity has been introduced to any considerable extent in marine installations, although the future gives promise of many new applications. Inasmuch, however, as practically all other applications aboard ship are dependent upon the lighting plant, it is natural that the best engineering skill has been occupied in perfecting the latter. As a result there have been developed for marine work a special type of generating set (engine and dynamo), special appliances (switches, junction boxes, cut-outs, stuffing tubes, water-tight globes and lanterns, etc.), special insulation for conductors, special methods of wiring, special forms of search lights, and special men who may properly be called "marine electricians." These apparatus and appliances differ materially from those in use on shore, and must be used under service conditions entirely dissimilar. Salt water, salt air, steam and the excessive heat of ship boiler and engine rooms, would play havoc in a very short time with the best modern shore installation, as they have, in fact, with many of the early ship plants, and if there is any place in the engineering world where the old axiom of "penny wise and pound foolish" should be stamped in large letters, it is on the plans of an electric marine plant. Such an installation is expensive when compared with similar work on shore, the first cost being perhaps 100 per cent. or more greater. Inferior material and workmanship are sometimes employed on shore, and fair results obtained by careful supervision and management of the plant. Such a policy is unwise under any circumstances, but aboard ship it is fatal; depreciation at once becomes heavy and rapid, and the marine plant has no manufacture or repair shop close at hand to repair damages or supply new material, nor are there always skilled electricians aboard ship to locate the cause of troubles and apply the remedy promptly.

It is wise for the naval architect in designing and installing a marine electric plant, whether it is for a man-of-war, merchantman or yacht, to see that the material is ordered from manufacturers who have made a specialty of marine apparatus and to have it installed by practical marine electricians, who, beside knowing something about electricity, know what a ship is and what the conditions are at sea. Finally, the plant should be put in charge of good, practical dynamo tenders, by which is meant men who are familiar with both steam and electrical machinery and their fittings. The best practice in electric installations is to be found in the various navies of the world, where specifications are always more rigid and work is better done (at greater expense of course) and more closely inspected. It is gratifying to know that in establishing and maintaining the high standards of excellence which have characterized the vessels of our new navy, and which have given these vessels an international reputation, the electric plants have kept pace with the other parts of the construction and equipment, and they are to-day the finest examples of marine installations afloat. In an able article on "Naval Dynamo Machinery," recently published in the proceedings of the United States Naval Institute, Lieutenant J. B. Murdock summarizes his experience of many years' study and practice, coupled with an extensive personal inspection of the best European naval installations, by saying that "our electrical plants are in most respects superior to those in use in other navies, but deteriorate more rapidly." This deterioration has been due in the past partly to the fact that strength and durability have been sacrificed to some extent (as admitted by Lieutenant Murdock) to secure the greatest compactness and least weight, and partly to the fact that the navy has had to create and develop a class of men competent to operate ship plants and to keep them in repair. The first difficulty has been remedied in the latest designs of apparatus now being furnished the navy, and the latter difficulty is gradually remedying itself through the school of practical experience; so that the deterioration in the future will undoubtedly be much less than it has been in the past.

The limits of this paper do not admit of a detailed discussion of the standard naval specifications, but every naval architect should study them carefully and apply them in all places where circuits, lights, apparatus or appliances are exposed to sea conditions; as, for example, on the upper decks, in the engine and boiler rooms, coal bunkers, storerooms, lower compartments, etc. The following brief resume covers some of the most important points.

LOCATION OF PLANT.

On war vessels the plant is properly considered as one of the vitals of the ship, and is always located below the protective deck, in a compartment by itself, near the boilers and as near the center of the ship as possible. These compartments require artificial ventilation, and even then are often uncomfortably hot (aboard the San Francisco, for example, the temperature ranges from 120° F. up). In some of the larger war vessels abroad there are two plants, located in different parts of the ship, one for ordinary service (above the protective deck) and the other for service in action (below the protective deck). The practice of dividing the plant, however, is more expensive in first cost, as well as in operation and deterioration, and is bad on general principles; it has never been adopted in our service. In some merchant vessels and yachts the plant is located in the main engine room, to save expense in piping and in extra supervision and attendance. The presence of moisture, live steam or flying oil in the main engine room, however, is very injurious to electrical apparatus, and where possible the plant should always be located in a compartment by itself, near the boilers (to insure a short lead for the pipes) and near the engine room, so that the engineer on watch can, with a few steps, see that the plant is receiving proper attention. The ventilation of the room should be good, and the temperature should not be excessive. The nearer the plant is to the center of the vessel, the less will be the cost of copper in the distributing circuits. With the earlier types of apparatus, care had to be exercised to locate the plant at a sufficient distance from the compasses, to prevent the influence of the magnetic field of the dynamo on the magnetic needle. The modern dynamo, however, with its closed magnetic circuit, has no appreciable influence on a compass needle at a distance of 15 feet.

CHARACTER OF GENERATING UNITS.

Engine and dynamo should always be direct coupled, that is, the armature shaft of the dynamo should be directly connected to the engine shaft. Belts take up room, are liable to stretch and slip (from the rolling or heeling of the vessel, or from oil) and reduce the efficiency of the plant from 5% to 15%, depending upon local conditions. The best practice is to provide a fixed coupling, readily accessible, between dynamo and engine. A reserve capacity should always be provided, if space allows. In the navy, the present practice seems to provide a reserve of from 25% to 33⅓% of the full load duty of the plant, a separate unit furnishing the reserve. Thus the full load service of the New York requires about 85 horse power dynamo capacity, which is supplied by two units, while a third, of 21 horse power, furnishes the reserve.

In some recent marine installations the reserve capacity is even greater (50% or more of full load duty) and it is always wise to have at least one reserve unit which can be kept ready for service at all times. In small vessels the reserve capacity must necessarily be less on account of the limited space available.

Engines should be of the open type, compact and strong, with rigid frames, large bearing surfaces and liberal clearance in the cylinders. Vertical engines occupy much less deck space than horizontal and are better adapted for ship service. There should be special provision for relieving the cylinders quickly of water, since a broken cylinder head or a cracked cylinder may cripple the plant seriously; both hand and automatic relief valves should be provided. Engines should be fitted for atmospheric and vacuum exhaust and should be able to operate satisfactorily with considerable variations in pressure, since they may have to take their steam from either the main or auxiliary boilers. The cups for all oil feeds should be grouped in front of the cylinders, where they are accessible and readily seen. There should be an automatic governor for speed regulation, and the speed should not vary more than 5 per cent. when full load is suddenly thrown on and off, for uniform speed of dynamo is very necessary for the satisfactory and proper operation of lights and motors. Vertical engines, whether simple or compound, should have two cranks, to insure smooth and quiet operation. With the present size of marine plants, the consumption of steam is so small, as compared with the total amount used for other purposes, that it has not been thought necessary or advisable to complicate the plant by introducing compound engines; but as the uses of electricity increase in number and variety (thus necessitating larger generating plants) it will probably be found economical to introduce the compound type. It is frequently used abroad at the present time.

The multipolar type of dynamo should be used, since it permits of slow armature speed, less weight, greater compactness and closed magnetic circuit. With the four pole type, only two brushes are necessary, and this is a distinct advantage. The commutators (of bronze or hardened copper) should have ample bearing surface and deep bars (1 inch to 1½ inches), so as to admit of considerable wear without replacement.

Dynamos should be compound wound (insuring automatic regulation of the electromotive force with change of load) and should be provided with a field rheostat to compensate for the change in the resistance of the field winding, when hot or cold. Armature and fields should be most carefully insulated, and the insulation resistance of both should be carefully tested before the plant is accepted; it should not be less than one megohm. The maximum rise in temperature above the surrounding air (measured immediately after a full load test of not less than four hours) allowed in any part of the dynamo must be small, for high internal heat is certain to impair or ruin the insulation in time, and then the plant is useless without extensive repairs. The naval specifications are very rigid in this respect, the maximum temperature rise being only 50° F. This makes the dynamos expensive, and a limit of 60° to 70° F. can be allowed with reasonable safety in the merchant marine, unless the location of plant is particularly unfavorable as to temperature and ventilation.

Dynamos and engines should always be tested together, as a complete unit. The full load efficiency of the unit, as measured by the ratio

$$\frac{\text{Electrical Horse Power at dynamo terminals}}{\text{Indicated Horse Power of engine}}$$

should be not less than 80%; with the best types of marine sets it runs as high as 83% to 85%. This applies to a unit with simple engine. The curve of efficiency falls off at light load (the efficiency being about 75% at ¾ load, 70% at ½ load, and 55% at ¼ load) and it should be arranged, therefore, that the units in operation at light loads should be loaded to at least 75% of the capacity.

The efficiency of units abroad is often determined by the consumption of water (in pounds per hour) per electrical horse power hour of output, and where the necessary apparatus is available for making the test it is undoubtedly more satisfactory than the measurement only of the indicated horse power of engines and the electrical horse power of dynamos. This method of test is now followed in large central stations, where triple and quadruple expansion, vertical, condensing engines are used, coupled directly to two dynamos, one at each end of the shaft, and varying in size from 600 to 2,500 horse power.

Three types of modern marine plants, as used in the navy, the merchant marine and in yachts in this country, are shown in the accompanying cuts.

The switchboard is an important accessory of the dynamo room, and, in common with all other appliances and devices used aboard ship, should be made of non-combustible material. The body of the board should consist of slate or marble and no wood is permissible in its construction. The instruments and connections on the board should be accessible and compactly arranged, and the positive and negative connections should be symmetrical. Any dynamo should be able to operate on any circuit, either single or in multiple with the other dynamos. Switches for different dynamos and circuits should be plainly marked so that the operator cannot make a mistake in their manipulation. The switchboard shown in Fig. 6 is a good example of recent marine work.

THE WIRING OF THE VESSEL.

This is the most difficult and expensive as well as the most important part of the installation. With the wiring

1. Read before the Society of Naval Architects and Marine Engineers, New York, November 15, 1894

installed many of the circuits are very inaccesible, and should a fault occor it is difficult to locate and still more difficult and expensive to remedy. It is imperative, therefore, that only the very best material and skilled labor obtaioable should be employed. Probably the best example of the highest grade wiring to be found is in our own naval vessels, and the specifications of the Navy Department are very rigid and complete. In Europe, and especially in England, it was the practice for several years to use what is known as the "single conductor system" of wiring, where one conductor only is run from the dynamos to the lamps, the hull of the vessel being utilized as the return conductor. The practice, however, has never found favor in this country, and it has a number of serious faults, with the single argument of cheapness in its favor. Recent practice abroad, evidently based upon unfavorable experience, does not favor it, and the system generally used is the two-conductor, insulated metallic return system. In England experiments have recently been made with a concentric cable, where one conductor is placed concentrically outside and insulated from the other, in one cable. Such a cable has the advantage of materially reducing the labor of wiring a ship, while still retaining the advantages of a completely insulated metallic circuit; but it is not wise, in the writer's opinion, to abandon our standard two-wire separate conductor system, until the success of the new method has been thoroughly demonstrated by several years' test at sea. The wiring should be divided in separate circuits, lights which are located in the same parts of the ship, and which are ordinarily used at the same time, being grouped on the same circuit. These several circuits are then carried back to the switchboard in the dynamo room where they are so connected that they can be independently controlled. The number of these circuits depends entirely on the size of the vessel and the number of lights required. In large vessels the expense of running each circuit back to the switchboard becomes very heavy, and, to reduce this, feeders are led to certain predetermined centers of distribution, where they are connected by means of suitable junction boxes to the circuit mains, which in turn light a certain section of the ship. In our naval vessels circuits are classed as battle circuits, including the lights needed in action, and lighting circuits, which include the lights for ordinary illumination. At general quarters all lights on the lighting circuits are at once cut off at the dynamo room switchboard. In a merchant vessel lights in the engine and firerooms, cargo spaces, storerooms and quarters should be on separate circuits, the sub-division of circuits being varied to suit individual vessels. On all exposed decks and in boiler and engine rooms, cargo spaces, storerooms and passengers' steerage, standard navy watertight moldings and fittings (junction boxes, switches, etc.), should be used. In the quarters of officers and cabin passengers, standard non-combustible fittings, such as are used on shore, can be safely used.

The present standard navy wire has no lead covering. It was formerly required as a mechanical protection and waterproof covering of the wire, but it was found that in handling the wire aboard ship, the lead covering was very apt to become broken, thus allowing water to soak in between the covering and the wire and the ragged, broken edges were frequently driven into the insulation of the wire to such an extent as to ground the metallic conductor to the hull of the vessel. Furthermore, it was practically impossible to discover defects in the insulation of the wire under the lead covering before the wire was put in place, and these defects often caused trouble later in service. The writer advocated the abandonment of the lead covering in 1887 after a year's experience with it on board the crusier Atlanta, where many of the circuits had to be entirely replaced during that period. The insulation of the wire should be depended upon to prevent troubles (the best rubber covered wire only being used) and a good heavy braiding affords all the mechanical protection needed beside the molding. Sample of all wire should be subjected to rigid electrical and physical tests before use. If a new ship is to be wired, the work should be done while the vessel is building, and the writer believes that the circuits for the engine and firerooms, the coal bunkers and for the exposed decks should be run in continuous iron tubes, having water-tight joints and an inner lining of insulating material. It is almost impossible to prevent trouble on these circuits with the ordinary wooden molding, and the iron tube method is successfully employed on shore in such places as breweries, dyeing establishments and chemical works, where the conditions are as trying as they are at sea. The loss in the wiring should not exceed 5%, and the expense is not excessive if this loss is limited to 3%.

The electromotive force of all United States naval plants is 80 volts. This standard has been adopted in order to permit the ose of searchlights and incandescent lamps on the same dynamos without the interposition of too much dead resistance in the searchlight circuit; and as the searchlights are an important part of the military equipment of a naval vessel, the adoption of a non-commercial voltage for the plant may be justified. But in merchant vessels no such important reason exists, and the voltage should range from 100 to 120 volts, so that commercial incandescent lamps can be used.

All wiring fittings and fixtures should be of bronze, or composition with bronze finish, no iron being used.

A ship plant, if installed in accordance with the best modern practice and on the general lines which have been described, can be relied upon for continuous and efficient service, provided it has a reasonable amount of care in operation, testing and inspection. The electric lighting of ships can be fairly said to have developed to a point where standard specification can be drawn and followed. It seems, therefore, proper to consider some of the possible future developments in the uses of electricity on shipboard for purposes other than illumination.

## II.

### FUTURE DEVELOPMENT.—ELECTRIC MOTORS.

The use of the electric motor is probably the most important development to be looked for aboard ship. On shore, where millions of dollars are now invested in single central station plants, the constant endeavor of the mangement is to make this investment more productive by keeping the machinery in operation with a paying load for as many hours out of the twenty-four as possible. During the day, the percentage of lights in use is very small and current is therefore sold for power purposes, thousands of horse power being thus connected in small units to the lighting circuits of the station. The advantages of the electric motor are now too well known to need repetition, and with the improvement that has been made during the last two years in their durability and adaptability for special applications, there are many places aboard ship where they can replace the auxiliary steam engines, with a saving of expense in first cost and operation and in space and weight. For military purposes, they can be used to advantage:

1. For ammunition hoists.
2. For handling the turrets of battle ships and monitors and also the heavy guns in these turrets.
3. For torpedo discharge apparatus.

Hydraulic or compressed air machinery has been largely used for this work in the past, and in this connection the following editorial, which appeared about a year ago and a half ago in an English technical journal of high standing is significant:

"Up to the present we have not felt able to advocate the general use of electric motors in place of hydraulic gear or auxiliary steam engines on board ship, but the effect of the recent frost on the Benbow discloses a weak point in hydraulic machinery which has no parallel in electric work. The gear of the heavy guns has been not only disabled, but has suffered such serious injury that it has been found necessary to take the greater portion of it to pieces, and to forward it to the manufacturers for reconstruction and repair."

Foreign navies have adopted electric motors for gun, turret, and hoist work quite extensively, and a number of ammunition hoists have recently been ordered for our own ships; while the turrets of the new battle ships will, in all probability, be operated entirely by electric motors.

For general purposes electric motors can be used to advantage for

1. Ventilating blowers.
2. Portable drills.
3. Portable pumps.
4. Operating machinery in engineer's machine shop.
5. Deck hoists, which are located at some distance from the boilers.
6. Operating valve of steam steering engine, and thus doing away with the long and awkward mechanical connection between steering wheel and rudder. The writer is of the opinion that a motor will eventually replace the steam steering engine itself. It requires about 15 horse power only, and the application can be made successful.
7. Opening and closing of water-tight doors. This application is simple and would greatly facilitate the prompt closing of doors in an emergency, either from the bridge or from any other desired point. If the water-tight doors of the ill-fated Victoria had been thus equipped they could have been closed within the sixty seconds immediately preceding the collision (when the order to close doors was given), and the ship might have been saved.[1]
8. Driving ice machinery.

There are certainly auxiliary steam engines that it is inadvisable to attempt to replace with electric motors; thus the auxiliaries in the engine and boiler room spaces (including blowers, ash hoists and certain spar deck hoists) require only short lengths of steam piping, and the conditions of service in the boiler and engine rooms are very trying to a motor; again the anchor engine requires from 40 horse power to 50 horse power, and if a motor is used the generator and wiring capacity of the plant must be considerably increased, while the motor is needed occasionally only and cannot be used for other purposes.

Such a general introduction of electric motors as here recommended necessitates an increase in the capacity of the generating plant of from 30 to 60 horse power (the heavy turret turning machinery having its own plant) depending upon the number of motors used, but this increase can be provided for in the existing dynamo rooms of all larger vessels, and the advantages derived warrant the additional expense. A modern vessel is filled with steam and exhaust pipes running to the auxiliary engines. Where they pass through living spaces they are a great discomfort; they are in constant need of repairs, and they are a menace to life in case of accidental bursting or breaking. Electric wires take up much less room, do not easily get out of order and do not injure any one if they do get out of order. The electric motor is cleaner, quieter, lighter and more compact than any other form of motor; they are in daily use on shore for many of the purposes enumerated, and there is no reason why their use should not be equally successful on board ship.

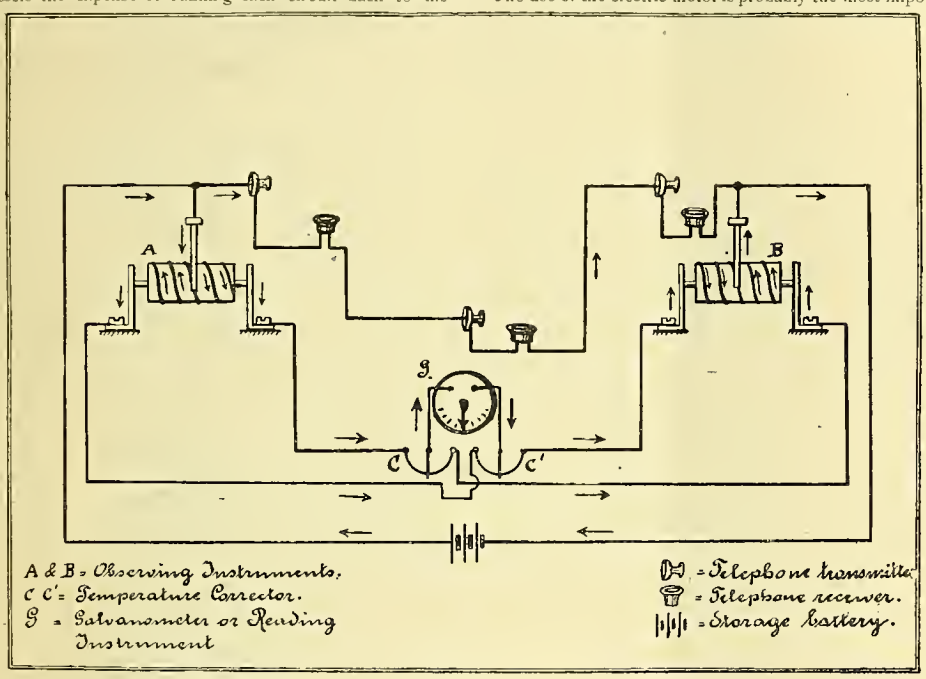



FIG. 3. ELECTRICITY ON SHIPBOARD: ITS PRESENT POSITION AND FUTURE DEVELOPMENT.—DIAGRAM OF CIRCUIT OF RANGE FINDER.

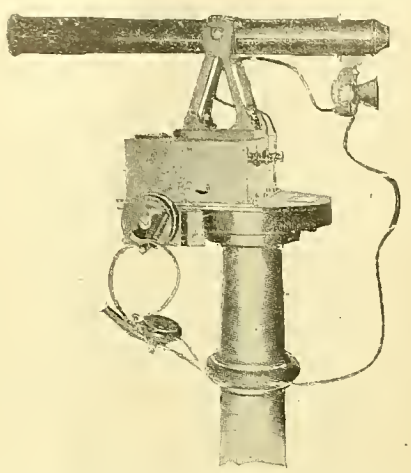


FIG. 1. ELECTRICITY ON SHIPBOARD: ITS PRESENT POSITION AND FUTURE DEVELOPMENT.—RANGE FINDER.

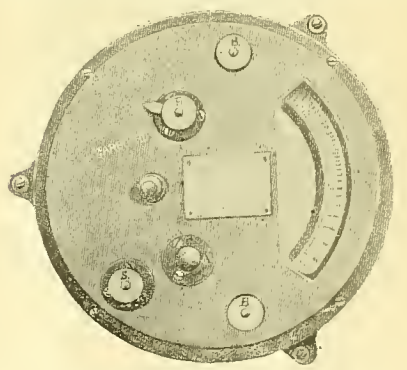


FIG. 2. ELECTRICITY ON SHIPBOARD: ITS PRESENT POSITION AND FUTURE DEVELOPMENT.—RANGE INDICATOR.

### SEARCHLIGHTS.

Searchlights have been in use on war vessels as a military weapon of offense and defense for several years, but their use as an aid to navigation is recent. Vessels now passing through the Suez canal use their searchlights and so make as rapid progress at night as in the day time. Vessels plying between New York and Savannah use their

1. Captain Bourke testified before the Court of Inquiry that it required three minutes, with a trained crew and under ordinary drill conditions, to close the doors of the Victoria.

searchlights in running up the Savannah river at night, and frequently save twelve hours' time from dock to dock in so doing. The Sound steamers throw the beam of their lights overhead in a fog, and the location of the vessel is indicated by a well defined luminous spot in the fog. The searchlight is frequently used for coaling ship or making repairs at night. These examples sufficiently indicate the uses to which an intelligent captain can put his search light. The general appearance, construction and operation of search lights has been greatly improved of late. There are two general types; those controlled by hand, requiring a man constantly at the projector, and those controlled by electric motors, so that an observer standing at a distance from the projector can, by means of a control stand, throw the beam of light at any desired angle of azimuth or elevation. The hand control is cheaper and has generally proved more reliable in service, but recent improvements in the electrically controlled projectors for the navy have so simplified them and increased their simplicity of operation that the arguments in favor of their general use have been greatly strengthened. The projectors should be placed well above the level of rails, guns, boats, etc., and in such a position as to command the greatest uninterrupted sweep around the horizon. The French have tried the experimeot of placiog the projector close to the water line, either by mountiog it at a lower deck port or by hanging it from an overhead support outside the ship. Theoretically, the area of contact of the beam of light on the water is increased by this arrangement and this is doubtless true in practice when the ship is at anchor in a harbor on a calm night. If the attempt, however, is made to use the projector in this position with the ship under way, it does not seem possible that it can escape injury from the waves nor that the beam of light will not be frequently shut in by the intervening seas.

### THE RANGE OR POSITION FINDER.

An instrument which will indicate quickly and with reasonable accuracy the distance of objects within the range of vision at sea is obviously of great advantage, both on account of its military value to a war vessel and as an aid to navigation, in coasting or making land. Several range finders have been devised both here and abroad, but by far the most complete apparatus is that invented by Lieutenant Bradley A. Fiske, United States Navy, and shown in Figs. 1 and 2.

This beautiful instrument, after tests extending over a period of five years, has just been officially approved and adopted by the Navy Department, and it has been adopted by several foreign governments as well. The following extracts from an official report of the commanding officer of the San Francisco show what it will do in actual service:

"In January last, when at Pernambuco, Brazil, I sent to the department a tabulated record of the errors of the range finder as determined in the various parts where the true distances could be gotten from the charts. The average error of all the observations was about six-tenths of one per cent. per thousand yards. Since that time I have always made use of the range finder at target practice, and in going into and out of port and in coasting. The range finder is thoroughly adapted to ship use, as is shown by the fact that its whole care and service are in the hands of three apprentice boys. These boys keep it in order, and go to it as their station at general quarters, getting under way and anchoring, and whenever the word is passed, 'man the range finder.'

"The range finders keep in order with almost no care whatever. There is a transmitter in the conning tower, one reading instrument in the starboard gangway, another reading instrument on the poop. The quiet and orderliness of target practice would be much increased if two reading instruments were added—one for the port gangway and one for the forecastle."

This report shows that the instrument is accurate and easily kept in order. In its construction the principle of the well-known Wheatstone bridge is applied very cleverly. Two standards, as shown in Fig. 1, are firmly secured to the deck, at the ends of a base line of known length. The standards are connected to each other and to a central point (usually the conning tower) by proper wires, there being also a telephonic connection between all these stations. Each standard carries a telescope, fitted with an electric contact and pivoted so as to travel over a graduated metallic arc. The diagram, Fig. 13, shows the usual connections. The galvanometer in the circuit is located at one of the standards. As the telescopes are directed on the same object (communication being constantly maintained between the two stations by telephone), they take different positions on the arcs, and a deflection is produced on the galvanometer, which deflexion is proportional to the distance of the object. By trigonometry the distances are determined for different angular positions of the telescopes, and the galvanometer is then graduated to read the distance direct in yards.

This distance is reported from the principal observing station to the conning tower by telephone and is then telegraphed to indicators, Fig. 2, placed conveniently about the decks. In future naval engagements the range finder will play an important part, and it may be a controlling factor in determining a victory, while in the field of navigation its use will be steadily extended.

### SIGNALING AND FIRING CIRCUITS.

For night signals the navy has recently adopted an improved form of the Ardois system, Fig. 4, suggested by Lieutenant A. P. Niblack, United States Navy. Four double lanterns, each lantern being colored half red and half white, are strung on a jackstay at the mizzenmast, the interval between the lanterns being 12 feet. An incandescent lamp is placed in each half of each lantern and connected by cable to a signal stand, Fig. 5, mounted on deck as desired. Various combinations of red and white lights are then flashed by a suitable switch at the signal stand and the lights are burned until the signal is reproduced on all the answering ships. Another switch is used to "blink" the upper light, thus indicating some special code signal. This system is rapid and very satisfactory up to distances of three to five miles. For "wig-wag" signaling, between two vessels a very neat, double masthead lantern has been developed, the red and white lights being flashed in succession by a suitable key. A "multiple fiber" incandescent lamp has been recently brought out in England for use with these masthead lanterns, the individual fibres or filaments being so fine that they lose their incandescence immediately the current is cut off. With the usual single filament lamp there is an after-glow when the circuit is opened, which is sometimes confusing in rapid signaling. The searchlight provides an excellent means of long-distance signaling, the beam of light being thrown overhead and waved to right or left. It has been reported that English war vessels have communicated successfully in this way in Chinese waters when more than fifty miles apart.

Electric firing circuits for firing the guns and torpedoes of war vessels will undoubtedly be used in the future; these circuits are so arranged that indicators at each gun and in the conning tower show when the gun is laid and ready for firing. The act of firing can then be performed by the pressing of a button in the hands of the gun captain or of

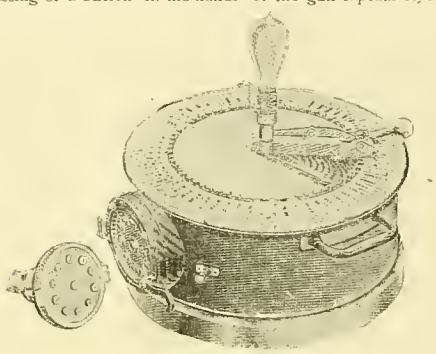


FIG. 5. ELECTRICITY ON SHIPBOARD: ITS PRESENT POSITION AND FUTURE DEVELOPMENT.—ARDOIS MARINE SIGNAL BOX.

the commanding officer, as may be desired. Such an arrangement will be appreciated for broadside or combination firing at close quarters.

### ELECTRIC LOGS.

The French navy has recently adopted an electric log, the invention of Rear Admiral Fleuriais. A set of revolving vanes on the log imparts, through worm gearing, motion to an ivory disc mounted in the log, and a spring makes contact with metallic plates placed at intervals on the rim of this disc. As this contact takes place, a bell is sounded aboard ship, once for every 24 revolutions of the vanes. The interval between signals is arranged 11 seconds for 8 knots, 8.8 seconds for 10 knots, 4.4 seconds for 20 knots, and is, therefore, of sufficient length to prevent errors. To indicate fractions of a second, the usual sand glass has been displaced by a pendulum indicator which

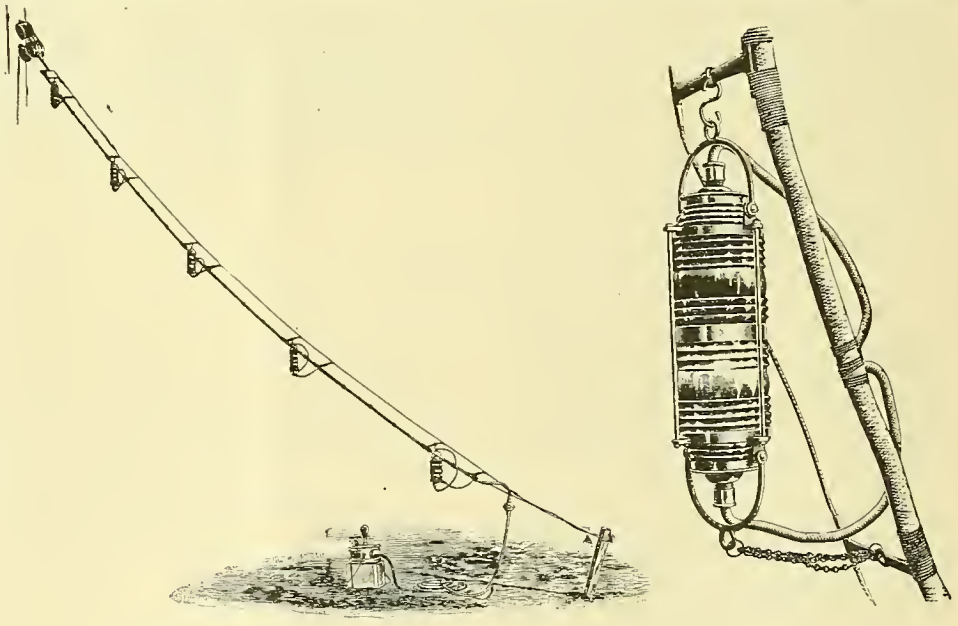


FIG. 4. ELECTRICITY ON SHIPBOARD: ITS PRESENT POSITION AND FUTURE DEVELOPMENT.—ARDOIS SYSTEM OF ELECTRIC SIGNALS.

beats at intervals of two-tenths of a second, and which is started at the moment of taking an observation. A mistake of half a second, with a period of 50 seconds, makes an error of only one-tenth of a knot in the speed of the vessel; if the observation is prolonged, the error is reduced. The apparatus is simple, and apparently gives good satisfaction. The log is about 9¾ inches in diameter and is not water-tight.

### THE ELECTRIC STEERING COMPASS.

Another French invention, by Lieutenant Bersier, French Navy, which will probably be introduced aboard ship, is the steering compass. Its object is to keep a ship on her course automatically and without the constant manipulation of the wheel in the hands of the helmsman. The following brief description of the device is taken from a recent technical journal. The electric spark of a Ruhmkorff coil is made to unite a pointer on the circumference of the compass card with either one of two semi-cylindrical, metallic plates, which are electrically insulated from each other and from the side of the compass box or binnacle. The coil is placed a few yards from the compass, and is supplied by an alternating current of from two to three amperes. The induced current of the secondary coil reaches the pivot of the compass through a flexible wire, and passes thence to the aluminum capsule that carries the sapphire, and follows along an aluminum wire or pointer which forms a radius of the north pole of the compass. As the ship deviates to the right or left of her course, the current leaps (through a distance of about an inch) from the pointer to the right or left hand insulated plate in the bionacle, and thence flows through one of two electro-magnets, which, in turn, close the circuit, in one direction of rotation or the other, of a small 150 watt motor. The shaft of this motor is keyed to the shaft of the rudder motor, which moves the rudder in the direction required to bring the ship back to her course. It is reported that the compass card is entirely uninjured by the current or spark, and that the device has been tested in squadron practice for two months with complete success.

### MEANS OF COMMUNICATION

Rapid communication, or exchange of orders, between distant parts of a large vessel is quite a problem. Verbal commands will not carry, and the person to be communicated with is usually out of sight. Electric gongs and bells are useful as calls, and speaking tubes are largely used. On the New York there is a speaking tube "exchange" below the protective deck and under the conning tower. Some twenty or thirty tubes converge at this point and connection is made between their ends by a short length of flexible tube, so that the commanding officers by calling the "exchange" operator can have his single tube connected with any other tube and vice versa. This system is crude, however, and the operator must be sorely perplexed when a number of calls are "blown in" at once. There is no way of distinguishing where the calls come from, unless the operator has a sufficiently musical ear to detect a difference in the notes of the tube whistles.

A far better system would be to have a direct telephonic connection between the conning tower and such other points as are desired, without any "exchange" at all. Such systems are now installed in many large office buildings and industrial establishments and give great satisfaction. Telephones have been tested aboard ship and found to be entirely reliable and an order can be given clearly by telephone that could not be understood at all through a speaking tube, especially when there is much noise or confusion at either or both ends of the line.

Electric engine revolution counters and direction indicators, thermostatic coal bunker indicators and helm indicators have recently been successfully developed. They are simple in construction and easy to operate. Some of these appliances, devised by Lieutenant Fiske, are now being installed on board the New York. The mechanical engine room telegraph signals now used for transmitting orders from the bridge to the engine room are a great improvement over the old gong and bell pull, but their installation is expensive and their operation not always certain, on account of the many changes of direction in the lead of the link chains, connecting the instruments on the bridge and in the engine room.

An electric telegraph signal will soon displace the mechanical device. Several such instruments have already been made and tested, both in this country and in Europe, with satisfactory results. A set of these instruments is also being installed aboard the New York.

### STORAGE BATTERIES OR ACCUMULATORS.

Storage batteries are largely used on shore, for both central station and isolated plants, and their manufacture has been much improved of late. Guarantees of 6 per cent. per annum depreciation can be secured from responsible manufacturers, and the care and operation of the batteries does not require specially skilled labor. The objections to their use aboard ship are their great weight and the presence of an acid solution, which gives off acid fumes. The weight is being gradually diminished with successive improvements; and the batteries can be fitted with water-tight covers to prevent slopping, while the fumes can be removed by

proper ventilation. They have the advantages for ship use that there is no moving machinery about them; they need not necessarily be placed in the dynamo room; they can be charged at any time during periods of light load, and when the heavy load comes on they can be used to help out the plant. They will probably find a proper field of usefulness aboard ship in the future.

ALTERNATING CURRENT APPARATUS.

The development of alternating current apparatus suitable for the simultaneous operation of incandescent lights, arc lights and induction motors has emphasized the advantages of this type of apparatus and has greatly extended its sphere of usefulness on shore. The alternating current induction motor has all the advantages of the direct current motor with the great additional feature of having no commutator or brushes. It has become very popular during the last year, and if the use of motors aboard ship continues to grow, it is quite possible that future ship plants will be installed on the alternating current system.

STEAM TURBINES.

Considerable attention has been attracted in England to the possible use of steam turbines, directly coupled to dynamos. Their great compactness and simplicity of construction makes them particularly suitable for marine plants, while their comparative high speed permits of the use of a very cheap dynamo; for in dynamo construction the cost of manufacture varies almost inversely as the speed. Several shore plants using the direct-connected steam turbine have been installed in England, and the reports thus far are very favorable. If they prove reliable in service, some sacrifice of steam efficiency can well be afforded with their introduction aboard ship, on account of their many compensating advantages.

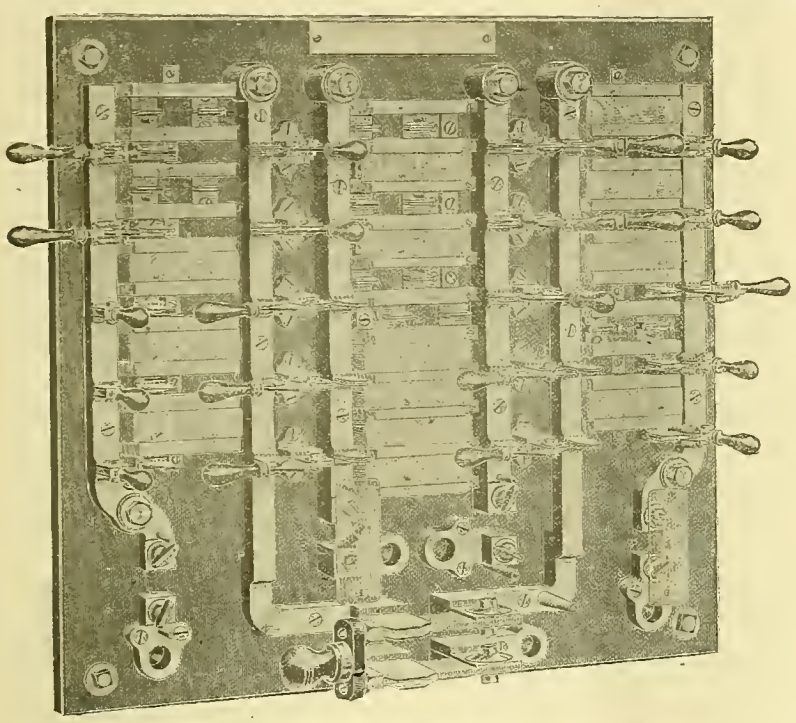


FIG. 6. ELECTRICITY ON SHIPBOARD: ITS PRESENT POSITION AND FUTURE DEVELOPMENT.—STANDARD SWITCHBOARD FOR NAVAL SHIPS.

In conclusion, a few words about the handling of the plant may not be out of place. The proper operation and care of electric machinery do not call for great technical knowledge, but they do demand the entire time and attention of a few thoroughly trained, practical men. Our seamen gunners in the navy are now trained for this work by an excellent course of practical instruction at the Naval Torpedo Station at Newport, and that these men have the right kind of training is shown by the fact that several of them have left the service to accept offers of more lucrative and important private positions on shore. Men for the merchant marine should have a similar training, and good men can be selected from those who have had practice in operating shore plants.

Applied electricity is a fascinating study, for its possibilities seem almost unlimited; but electric machinery, in common with all other classes of machinery, must always depend for its successful operation upon a reasonable exercise of human intelligence in its care and supervision.

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An election in Harrison township which includes Terre Haute, Ind., has been ordered for December 17th on the proposition to vote a donation of $20,000 for an electric railway between Terre Haute and Brazil. The company has been incorporated with $100,000 capital stock, and it is estimated that it will cost $125,000 to build the line and locate a power house at Seeleyville, which is about half way between the two cities. Of the $100,000 stock $20,000 has been subscribed in Terre Haute, and the promoters of the road say they have assurances of twice that amount if the $20,000 donation is secured. The right of way has been secured along the north side of the old government national road. It is proposed to run cars every thirty minutes. There will also be express cars, it being expected that considerable business may be done in the shipment of the lighter articles of what is usually handled as freight. The passenger fare is to be 15 cents. The fare on the Vandalia road is 50 cents.

## Automatic Electric Pump Control.

In situations where water is used from overhead pressure tanks, as in breweries, locomotive charging tanks and the like, the pumps used to fill the tanks are usually looked after by workmen, who watch the floats and gauge the water supply accordingly. It frequently happens, however, that the man is required elsewhere, so that the tank is neglected and not kept filled. To perform this work automatically the Allgemeine Elektricitäts company of Berlin has perfected a combination of devices, by the employment of which no attendance is necessary.

As shown in the diagram, Fig. 1, the tank is provided with a float, which, by rising and falling, opens and closes a switch controlling a small motor. This motor is connected with the large directly coupled pump motor by a novel switching apparatus, and the principal motor is thus operated as required.

The operation of the device is as follows: As soon as the water has reached its lowest level the float, acting on contact $C_1$, Fig. 1, closes the switch at the tank, and as the contact at $A_1$ is already closed the small motor $N$ is set in operation. This motor, by suitable mechanism, lifts the rod $H$ and the contact brushes $E$, cutting out the resistance in the starting rheostat $W$ of the principal motor $M$. Immediately following this action, by means of the disk-pin $S_1$ and the switch $A$, the circuit controlling motor $N$ is broken, and the main motor starts up to fill the tank. The apparatus at this moment is shown in Fig. 1, and also in Fig. 2, the latter being a perspective view of the small motor and the rheostat mechanism.

Gradually the inflowing water raises the float, until contact $C_2$ is closed, making connection with the switch $A_2$ and again starting motor $N$. This, in turn, sets in motion the roller $R$ under the cam on the upper end of the rod $H$, and this rod, being set free, sinks down and cuts in the resistance of $W$, stopping the motor $M$ and consequently the pump. At the same time pin $S_2$ has closed the switch at $A_1$, so that when the water again falls to the lowest level the operation is repeated.

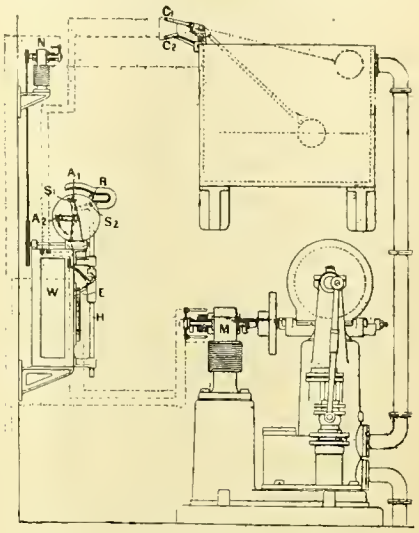


FIG. 1. AUTOMATIC ELECTRIC PUMP CONTROL.

## A Big Magnet and a Big Story.

This story is told by a Washington correspondent: The most astonishing contrivance for warfare recently developed is Col. W. R. King's gigantic electro-magnet, of which something has been said in the newspapers within the last few days. This engineer officer of the army has constructed on the top of a fort at Willet's Point, near New York, a great horseshoe composed of two big cannon and a metal bar, with several miles of heavy insulated telegraph wire wound around the muzzles of the guns for spools. Thus has been produced the most powerful magnet in the world, a current of electricity being supplied from a dynamo. As alleged, it is capable of deranging a ship's compass at a distance of six miles, which would be useful in case hostile vessels tried to approach at night or in a fog. They would be apt to find themselves ashore unexpectedly. It has been suggested that a row of such magnets along the walls of a fort might be used to draw the small arms out of the hands of an on-coming enemy. This idea is the same as that of the "Arabian Nights" story, in which the iron nails were pulled out of ships that ventured too near the mountain of loadstone.

## American Institute of Electrical Engineers.

The office of the American Institute of Electrical Engineers' which has been at 12 West Thirty-first street, New York, since May, 1890, has been removed to rooms 1009 and 1010 Havemeyer building, 26 Cortlandt street, New York.

This change has been decided upon by the council after careful consideration during the last three months by a committee composed of James Hamblet, chairman, Prof. F. B. Crocker and H. A. Foster. The inconvenience of the uptown location has long been apparent to officers and members living in the city, as well as visitors from a distance. The choice of the Havemeyer building was due to its central location in the electrical district and its convenience to lines of travel. It has entrances on Cortlandt, New Church and Dey streets. It is immediately adjacent to the Sixth avenue elevated railroad station; one block from the Ninth avenue station and the Broadway cable line; two blocks from the Pennsylvania railroad ferry, and three from that of the Central railroad of New Jersey. The Institute meetings will be held at 12 West Thirty-first street as heretofore until further notice. The office will be open from 9 A. M. to 5 P. M. It is equipped with a long-distance telephone and district messenger service. Over 100 electrical, mechanical and engineering periodicals will be found on file. The rooms front west and command a fine view of the Hudson river. Members visiting New York will find the rooms as convenient for their accommodation as were those at the World's Fair.

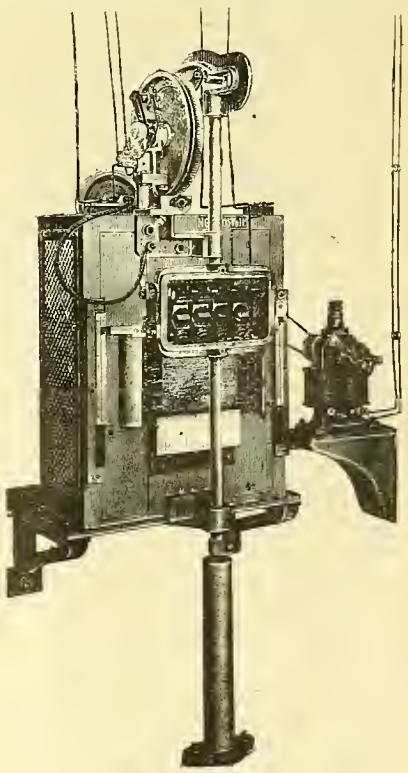

FIG. 2. AUTOMATIC ELECTRIC PUMP CONTROL.

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CORRESPONDENCE relating to electricity or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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CIRCULATION, 16,630.

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THE legal controversy at Washington this week occupies the attention of the entire electrical fraternity. Much depends upon the decision in the Bate Refrigerating company's case, which, from an insignificant action, has grown to represent a controversy in which many millions are involved. It may be said that much of the future practice in patent cases will depend upon the ruling of the Supreme Court in this proceeding, but the immediate interest, of course, centers in its application to the telephone and incandescent lamp litigation.

MR. GREENE'S paper on "Electricity on Shipboard: Its Present Position and Future Development," which was read before the Society of Naval Architects and Marine Engineers at New York, November 15th, and is presented elsewhere in this issue, is a carefully prepared article on a subject that has not received the attention its importance demands. Mr. Greene's contribution is a valuable addition to the literature on the subject and will doubtless awaken interest in this field, in which there is so much promise. The paper is worthy of careful perusal.

THE government is just beginning to realize what has long been apparent to shrewd business men in all parts of the country—that is, that the telephone as a means of communication between the several departments of large concerns, or between the heads of departments and the employes under their direction, is a great economizer, and aside from the convenience of the arrangement is a very desirable addition to the office equipment from a financial point. The secretary of the interior has decided to introduce the telephone in that department of the government, and a complete telephone exchange system will be established, including not only the department building proper, but also the Pension Office building and the Geological Survey. This will be quite an extensive equipment, and the fact that the government has advertised for bids will greatly encourage newcomers in the field. The exploiters of several new instruments have expressed a desire to have a comparative test made of the efficiency of their systems, each claiming superiority over all the others. The present occasion, it seems, affords an excellent opportunity to all who honestly believe in the claims they make for their respective instruments. To decide the merits and relative efficiency of the competing systems, why would it not be a good scheme to have a public test? Each concern entering the competition would be compelled to furnish adequate bonds to insure the installation of an equally good system, should the judges report in favor of its equipment. Such an arrangement would have the merit of being free from all outside influences, and the government would be amply repaid for its trouble by securing what would undoubtedly be the best telephone exchange system in the world to-day.

There is reason for congratulation whether this plan is followed or the contract awarded without practical demonstration of the superiority of the equipment chosen. The fact that the government has recognized competitors of the Bell interests, to the extent of seriously asking for proposals from them, will be considered a distinct advantage by all who are interested in this field.

NEW YORK has not yet secured rapid transit, and although the voters of the city have signified their approval of the measure submitted to them at the last election, it is not likely that the project will go through without considerable opposition. This was to have been expected, but now it can be safely relied upon. The interests opposed to the municipal rapid transit scheme will place every possible obstacle in the way of the commission. Although the taxpayers of the city, by a vote of about 120,000 to 36,000, declared in favor of the project, the opponents of the measure continue to pose as disinterested advocates of the rights of the people. They say that "no irreparable mischief has been done yet, and the city may after all escape it." The Rapid Transit Commission, it is pointed out, has not even decided upon the route and the plan of the road it is charged with constructing; and again, when it has settled these points, a multitude of details remains to be arranged before the requisite contracts can be drawn up and submitted to bidders for the work. Next, it is claimed, it is possible, and indeed highly probable, that no responsible person or corporation will become a bidder under the onerous conditions which the commissioners must of necessity impose in order to fulfill their promise to secure the city against loss, and finally, it is announced, "before a spade can be turned, the validity of the act will have to pass the ordeal of the Court of Appeals and be affirmed by it." In conclusion, an advocate of the "L" road interests sums up the situation as follows: "Those simple-minded people who think that, because a majority has voted for the project, they are to be carried immediately from the Battery to Harlem in fifteen minutes, and get seats at all hours, are considerably mistaken." This utter disregard of the expression of public opinion as recorded on election day could not find expression anywhere else in the country, but there is no doubt that the project will be subjected to all the delays here outlined and to as many more as the opponents of the measure can invent.

QUITE a remarkable statement was made by Vice-president Payne of the Milwaukee Street Railway company before the railroad committee of the city council when the subject of passing a 4 cent fare ordinance was under consideration. It has frequently been asserted that the company is not now, and never has been, under the present management, a paying concern. When the change from horses to electrical equipment was made and all the lines of the city consolidated under one management, it was claimed that the company was charged excessive prices for machinery and construction work, and that despite the high rate which the company paid it did not succeed in getting superior work or first-class equipment. Some of the machinery was faulty in design and poorly constructed, and as a result the company has been kept busy paying repair bills.

Now these reports are verified by Mr. Payne; in fact, his statement shows a condition of affairs much worse than was suspected. According to Mr. Payne, the company has never earned any dividend or return upon its capital stock, nor has it ever earned the interest upon its bonds. It has already defaulted twice upon the interest upon its bonds, and will default upon interest falling due December 1st. He further alleges that it costs the company more than 4 cents to carry any passenger upon its lines. If this be true, and there is no reason to question the accuracy of the statement, the best thing to be done is to thoroughly overhaul the road and put it in working order. The present condition of affairs, it is explained, is due to the fact that in addition to the increased cost of operation, the company has been obliged to expend nearly $60,000 during the last year in street improvements that do not add to the earning capacity of the road. Reverting to the question of the proposed reduction of fare Mr. Payne says that the action of the public authorities in cutting down the fare below 5 cents, which is the universally accepted and established rate all over the United States, with very few exceptions, would give the city a very unenviable reputation in money centers and make it extremely difficult to interest capitalists in any enterprises located in Milwaukee. Similar movements have already had the effect of frightening capitalists, and the street railway company has already had trouble in securing loans to make needed improvements. On this point Mr. Payne says: "I have hoped and expected during the present year to make certain extensions of our lines into the suburbs, which would have been of great convenience to the public and of material advantage to the property through which the lines would have run, but I was unable to obtain the necessary capital to enable us to do so, by reason of hostile action of certain public officials, who proposed to add heavy burdens to the company, and also by reason of threatened legislation bearing upon the matter now under consideration." It may be of interest to know that the city council has decided not to attempt to purchase the street railway lines for the city.

THE Field Columbian Museum of Chicago is a great and beneficent institution and it seems undoubtedly destined to take rank with the very foremost of American collections of similar character. Its value to the community in an educational sense is already considerable, and its importance in this direction is sure to be greatly augmented by the intelligent direction and ample means of the management. But there is one very important development of modern life which appears to have been overlooked by the directors, up to this time, in organizing the departments of the museum. This omission consists in neglecting to make suitable provision for an exposition of the remarkable manner in which, within the span of hardly more than half a century, applications of electrical energy have been developed to their present commanding position in the service of mankind. There is no need to dwell on the scientific and industrial importance of this nineteenth century marvel; the story has been often told in enthusiastic phrase. There should be, beyond question, an electrical department in the Field Columbian Museum if it is to be complete and is to reach its highest usefulness. We desire to attract the attention of the directors of the institution to this fact, and in doing so we are confident that we express the sentiment of the entire electrical fraternity of the West.

Chicago, the scene of the great electrical display at the World's Fair, is well adapted to be the home of such an electrical department as the Field museum should have. It has thousands of inhabitants who are directly interested in electrical enterprises and it is the great electrical center of the West. The electrical extension here is constant, and is just now particularly noticeable in railway work. The city has large electrical factories, great central stations for light and power, hundreds of isolated plants, wide-reaching means of electrical communication, dozens of important business establishments engaged in selling electrical supplies, and electrical engineers, students and contractors of all grades. All of the scientific and commercial men thus engaged would have an active interest in the electrical department of the museum. We know of one electrical man who has now in his possession several examples of old-time electrical apparatus of great interest that he will gladly donate to the museum if suitable arrangement is made for receiving them. A little effort would doubtless result in many accessions of this character from Chicagoans alone. The surrounding states of the West, with their many important electrical enterprises and educational institutions, would also take a friendly interest in a permanent electrical collection at Chicago.

But in establishing an electrical department, as we believe they will do, the museum directors will have a higher aim than the gratification of any local or sectional pride. They will realize the great benefit to the industry at large of a great and growing collection of electrical experimental apparatus, original working instruments and machines, and the literature of this great subject. There is no public museum in the country which has an adequate electrical department. Why should not the Field Columbian Museum grasp its opportunity and supply this lack? A competent man should be employed to gather material in this country and Europe which should, if possible, cover the entire field of electrical development. Knowledge, time and money will be needed to make the department what it should be. But the directors of the Field Columbian Museum have the opportunity to establish, in the youngest of the great cities of the world, the greatest museum of the youngest great industry. We cannot believe that this enticing possibility will be longer neglected.

## Electrical Precipitation from Cyanide Solution.[1]

By A. Von Garnet.

The Siemens & Halske gold recovery process has been tried on a large scale at the Worcester mines, South Africa, for the last four months, after long and exhaustive experiments at the works of the Rand Central Reduction company.

Although the electrical precipitation of gold, extracted from ores by cyanide, has only been recently introduced in South Africa, it has been in use in Europe and Asia as far back as 1888. The author having been connected with the process from the beginning, he is thereby enabled to give some information concerning its development, based on actual working data, which may be of general interest. In 1887 Dr. Siemens found that the gold anodes used in electroplating at his works in Berlin lost weight when standing idle in the cyanide liquor without any electric current passing through the bath. This fact, backed by the statement of chemical authorities that gold is soluble in cyanide first induced him to try the use of cyanide solution to extract gold from ores. In the same year he built a small plant to make experiments on concentrates produced at Siebenburgen. The gold was precipitated from the solution both by electrolysis and with zinc filings. It was found, however, that the zinc method gave good results with strong solutions only, while the electric precipitation was equally effective with either stroog or weak solutions, and its efficiency was not lessened by the presence of caustic soda. Dr. Siemens therefore decided to use electrolysis only. Early in the year 1888 he commenced operations on a larger scale, and engineers were sent out to several different countries. Two went to Hungary, another to America, and the author to Siberia. The results obtained were generally satisfactory, although, as might be expected, they varied considerably owing to the different conditions existing in the respective places. Nothing was done in this country at that time as the patent question was not then settled. Except to mention the fact that Mr. Siemens was the applicant for and holder of the first patent in the Transvaal for the extraction of gold by means of cyanide, it is not necessary to discuss this matter, as such questions are beyond the scope of a technical paper.

It is necessary to point out some of the reasons why such a large number of electrolytic processes have not succeeded commercially. The electric current decomposes a solution of metallic salt, the metal being deposited on a negative pole, while the metalloid is liberated at the positive pole of the electrolytic cell. In a fixed time a given electric current will deposit a certain quantity of metal, which quantity varies for different metals in direct proportion to their electro-chemical equivalents. This law holds good only for solutions strong in metal, but with very dilute solutions, as in use in the cyanide process, the current does not find sufficient of the metallic compound present at the electrodes, and consequently decomposition of water also takes place. For this reason, to make the efficiency of the precipitation as great as possible, constant diffusion of the solution is requisite. In order, therefore, to create an artificial diffusion, a mechanical movement of the solution is important, and the most economical and efficient way of effecting this is to allow a slow but steady flow through the precipitation boxes. But it is still more important to give a very large surface to the electrodes. In fact, a better effect is obtained by doubling the number of plates than by increasing the current ten fold. For this reason mercury cathodes cannot be used with good results. In order to precipitate 100 tons of cyanide solution containing five pennyweights of gold per ton in 24 hours, about 10,000 square feet of surface is required. If the bottoms of the precipitation boxes were covered with mercury, it would be necessary to have it at least a quarter of an inch deep, to make up for difference of level and thus insure that the whole surface should be covered. This requires 200 cubic feet of mercury, weighing 80 tons. Not only the initial expense but also the trouble in cleaning up makes the use of the mercury in this way as an electrode impracticable. The vertical position in which metallic plates can be placed has the great advantage of keeping the surface of the cathodes clean, as any solid matter entering the boxes in suspension sinks to the bottom of the latter, no obstruction being offered to its downward course. Sheets of solid metal (as copper) coated with mercury have also been tried, but have been unsuccessful, because the mercury, owing to the action of the current, will penetrate the copper and form a dry amalgam which does not adhere to the plate. To obtain a satisfactory cathode a metal must be used which will fulfill the following conditions: 1. The precipitated gold must adhere to it. 2. It must be capable of being rolled out into very thin sheets to avoid unnecessary expense. 3. It must be easy to recover the gold from it. 4. It must not be more electropositive than the anode in order to prevent return currents being generated when the depositing current is stopped.

The most suitable metal for the purpose is lead, which is therefore used in the Siemens process, and which meets all the requirements of the case. Not less important is the question of anodes. By the action of the current a metalloid is liberated at the positive electrode, and the latter, when a metal, begins to oxidize. Carbon could be used as an anode, but it will not withstand the action of the current, and soon crumbles into a powder which decomposes cyanide. This finely divided carbon is in suspension, and cannot be removed from the solution by filtration. Zinc used as an anode forms a white precipitate of ferro-cyanide of zinc by the reaction of zinc oxide upon ferro-cyanide formed during the leaching. Similarly of iron anodes form Prussian blue by the reaction of oxide of iron and ferro cyanide In consequence of this reaction the amount of ferro-cyanide in the cyanide solution does not increase. From the Prussian blue the cyanide can be recovered by dissolving it in caustic soda, then evaporating the solution, and finally smelting with potassium carbonate. This last process has been carried out only on a small scale, about 50 pounds at a time, but a nice clean cyanide potassium was obtained. In the treatment of tailings this regeneration of cyanide is not of great importance, but with concentrates, which decompose the solution with formation of ferro-cyanide, it will effect a considerable economy. In order to precipitate the gold from cyanide solutions only a very weak current is required; that is to say, a density of about .06 ampere per square foot. With cathodes about 1½ inches apart, four volts is sufficient to produce this current strength.

The advantages gained by using a weak current are: 1. The gold is deposited hard on the plates. 2. The iron anodes are preserved for a long time, as their waste is in proportion to their current strength. In a plant treating 3,000 tons per month 1,080 pounds of iron are destroyed in that period. 3. Little power is required: 746 watts equal one horse power. A 3,000 ton plant requires 2,400 watts, equal theoretically to 3½ horse power, and actually requiring about five indicated horse power.

The most important feature of electrical precipitation is that it operates on the solution quite independently of the amount of cyanide or caustic soda that it contains. Precipitation by means of a chemical reaction is invariably more complete with a solution strong in cyanide than with a weak one; but with electricity is absolutely of no importance whatever. Therefore, in the treatment of tailings very dilute solutions can be used, the only limit being a sufficient amount of cyanide to dissolve the gold satisfactorily. Moreover, however acid the solution may be, when entering the boxes the precipitation takes place equally well, the same amount of gold being recovered as from a natural or alkaline solution. There are none of the complications arising from the formation of lime and alumina and hydrate of iron, which, under similar circumstances, sometimes occasion so much trouble in the zinc process. Everyone here present is aware that a solution containing .03 of cyanide will dissolve gold just as effectively as a solution containing .3 per cent., provided a longer time is allowed for treatment. In the first case the decomposition of cyanide in the tailings is much less than in the second, and a corresponding economy is effected. The moisture in the original tailings being usually about the same as that contained in the residues, there is, as a rule, no chance to give a large water wash after the cyanide treatment is finished. The residues discharged contain 10 to 15 per cent. moisture, carrying about .1 to .05 per cent. cyanide solution when the zinc process is employed. This is equivalent to ¼ pound of cyanide per ton of tailings. This loss may be reduced to $\frac{1}{16}$ pound by using as weak wash a solution containing only .01 per cent. cyanide, which strength will be perfectly suitable for electrical precipitation, though difficult to deal with by the chemical method. Having described the principles involved in this process, it only remains to give some details as to the practical working results obtained at the Worcester works. There are now in use five leaching vats of two feet in diameter, with 10 feet staves, each holding 2,700 cubic feet. One tank is discharged and filled each day. The strong solution used contains from .05 to .08 per cent. cyanide, and the weak washes .01 per cent. The actual extraction of fine gold has averaged 70 per cent., while the consumption of cyanide has been ¼ pound per ton of tailings treated. The precipitation plant consists of four boxes 20 by 8 by 4 feet. Copper wires are fixed along the top of the sides of the boxes, and convey the current from the dynamo to the electrodes. The anodes are iron plates 7 feet long, 3 feet wide and ½ inch thick. They stand on wooden strips placed on the bottom of the box, and are kept in vertical position by wooden strips fixed to its sides. In order to effect circulation in solutions passing through the box, some of the iron sheets rest right down on the bottom, while others are raised about one inch above the level of the solution, thus forming a series of compartments similar to those of a zinc box, the difference being that the solution passes alternately up an down through successive compartments. The sheets are covered with canvas to prevent short-circuit. The lead sheets are stretched between two iron wires, fixed in a light wooden frame, which is then suspended between the iron plates. The boxes are kept locked, being opened once a month for the purpose of the "clean up," which is carried out in the following manner: The frames carrying the lead cathodes are taken out one at a time. The lead is removed and replaced by a fresh sheet, and the frame returned to the box, the whole operation taking but a few minutes for each frame. By this means the ordinary working is not interrupted at all, and the cleaning out of the boxes, which is necessary in the zinc process, is only required at very long intervals. The lead, which contains from 2 to 12 per cent. of gold, is then melted into bars and cupelled. The consumption of lead is 750 pounds per month, equal to 1½d. per ton of tailings. The working expenses, including filling and discharging tanks, come to 3s. per ton. When working on a larger scale the expenses will, of course, be reduced.

### Discussion.

In the course of the short discussion which ensued it was stated that the costs at the Worcester worked out as follows: Filling and discharging, 10d. per ton: cyanide, 6d.; lime, 1.2d.; caustic soda, .5d.; lead, 1.1d.; iron, 2.2d.; white labor, 5.2d.; native wages and food, 1.9d.; coal, 4.6d.; stores and general charges, 3.2d.; total, 3s.

Mr. Butters observed that the charges for the white labor, viz., 5d. per ton, were very high. They were only treating at the Worcester 100 tons per day. If they were treating 8,000 tons per month instead of 3,000 the cost would be the same, and white labor should only be one-fifth of the present charge. The high rates were for white labor and coal. Coal would be nearly constant for additional plant; but while white labor would not be constant with a larger plant, coal would perhaps be 1d. cheaper, and white labor would come down to 1d. per ton instead of 5d. That meant a saving of 4d. per ton in larger works. In the case of the McArthur-Forrest process the cost of zinc came to 2½d. on every ton. The new process had lead and iron and coal as heavy items against cyanide, zinc and coal in the McArthur-Forrest process. Mr. Von Garnet had taken iron at 2.2d., but he had written the cost off by depreciation in one year, whereas it would last probably for three years, but all the costs they had taken at the outside. They thought the total cost would come down to 2s. 6d. per ton with an ordinary cyanide plant of from 6,000 to 8,000 tons per month. Of course the gain of the process was in the lesser cost of cyanide. Anybody could work at 4s. per ton, but they thought they could reduce that by 1s., or may be 1s. 6d. If they could bring down the cost to 2s. 6d. there would be an enormous gain. As the boxes had only to be opened once a month, that represented a great advantage in various ways.

Lionel Phillips, president of the Chamber of Mines, who occupied the chair, said the facts revealed in the paper were of a startling nature and of the utmost importance to the mining industry. Mr. Butters said that as for the royalty to be demanded, he and probably his board would be content with one of 3 per cent. lower rather than higher than that figure.

1. Read before the Chemical and Matallurgical Society of South Africa.

## McArthur-Forrest Patent Declared Invalid.

A cablegram from London dated November 8th announces that Justice Romer, in the chancery division of the High Court of Justice handed down his decision in the McArthur-Forrest cyanide gold extraction process patent litigation. The action was brought by the owners of the patent against alleged infringers, and the defense was that the process was old and the patent invalid. The decision is against the owners of the patent and may have considerable effect in America, where the process is also patented and in use.

## High Voltage Shock Without Pain.

Dr. P. S. Donnellan of Philadelphia, writing to the *Medical News*, describes a case occurring in the practice of his colleague, Dr. W. M. L. Coplin, as follows:

On the 20th of April, 1894, J. R., aged 44 years, while engaged in repairing broken wires for the Bell Telephone company, grasped the ends of the wire that had crossed an electric light wire conveying one thousand volts. He received the full force of the current through his body and was immediately rendered unconscious. He was thrown violently to the ground, and could not be released until the current was broken by a fellow lineman, who cut the wires apart with a hatchet.

The man was brought to St. Mary's Hospital within half an hour from the accident, and I saw him a few minutes after his admission. He was in profound coma, with pupils widely dilated and irresponsive to light, breathing stertorous, face pale and bathed in perspiration. About ten minutes later he vomited, and then became wildly delirious, so that it required the combined efforts of three men to keep him in bed. He moaned and cried incoherently, and tonic and clonic convulsions of a severe type succeeded each other with great rapidity. At this time we were unable to take his temperature on account of his extreme restlessness, but to the hand it appeared about normal. His respirations now lost their stertorous character, and became more of the Cheyne-Stokes variety, averaging about ten per minute for two hours after his admission. The pulse was 80 per minute, of high tension.

The man was given morphine by hypodermatic injection; and as the delirium and convulsions did not abate, the injection was repeated, and soon afterward he gradually quieted down. As his respirations were alarmingly feeble, he was given strychnine by hypodermatic injection with excellent effect. He fell into an apparently normal sleep, from which he awoke four hours later, conscious, but slightly dazed, and feeling, as he expressed it, "tired and sore all over." On my visit to the hospital next morning I found that he had slept well during the night; his temperature was 98.8, his pulse 72, his respiration 18. He complained of pain from a number of severe burns that he received during his contact with the wire. These burns were distributed irregularly in lines over the back, arms and legs, and evidently were caused by the intensity of the current, as the clothing which covered the affected areas showed no signs of having been scorched.

On questioning the patient as to the nature of the accident, he remembered perfectly all the incidents of his morning's work up to the time that he grasped the wire that conveyed the shock through his body. After that moment he had not the slightest knowledge of what had occurred, and did not suffer the least pain until he awoke at 6 P. M., as already stated, to find himself in bed in the hospital. The patient made an excellent recovery.

In view of the employment of electricity by the authorities of certain states for the purpose of putting condemned criminals to death, the facts of the case related are of interest.

In another case elsewhere, according to the statement of our patient, he was absolutely insensible to pain from the instant he received the shock; even the actual discharge of the current caused him no suffering; and were it not for the burning of his skin, he would not have been aware that he had met with an accident.

While it is to be regretted that the public is greatly exposed to accident from contact with the currents of high tension on account of the almost universal employment of electricity as a motive and lighting power in our large cities, it seems to me that, so long as capital punishment has to be enforced as a legal penalty, the electric current, properly applied and of sufficient high tension, is the most humane agent yet devised for putting condemned criminals to death.

## Proposed Telegraphic Historical Society.

Preliminary steps have been taken looking to the formation of a telegraphic historical society for the purpose of collecting, preserving and publishing historical information relating to the establishment and development of the telegraph in North America. A meeting will be held in the Smithsonian Institution or other suitable building at Washington, D. C., Wednesday, December 5th, at 2 P M. On that occasion a constitution will be adopted, officers elected

and plans for carrying forward the purposes of the society will be determined upon.

The movement has already enlisted the support of many men well known in telegraphic circles, including Thomas D. Lockwood, American Bell Telephone company, Boston, Mass.; Franklin L. Pope, Great Barrington, Mass.; Charles A. Tinker, general superintendent Western Union Telegraph company, New York; J. H. Emerick, general superintendent Postal Telegraph company, New York; L. C. Weir, prsident Adams Express company, New York; S. B. Gifford, superintendent Western Union Telegraph company, Syracuse, N. Y.; Charles Selden, superintendent B. & O. Telegraph company, Baltimore, Md.; William Kline, superintendent telegraph, Lake Shore Railroad company, Toledo, Ohio; A. H. Bliss, Chicago, Ill.; George M. Dugan, superintendent telegraph, Illinois Central Railroad company, Chicago, Ill.; C. W. Hammond, superintendent Missouri Pacific Railway company, St. Louis, Mo.; W. C. Walstrum, Roanoke, Va.; B. F. Dillon, superintendent Western Union Telegraph company, Jacksonville, Fla.; Morell Marean, manager Western Union Telegraph company, Washington, D. C.; W. H. Allen, manager Postal Telegraph company, Washington, D. C.; D. P. McKeever, superintendent Pennsylvania Railroad company, Washington, D. C., and George C. Maynard, Washington, D. C.

## Storage Battery Litigation.

A decision was handed down on November 15th in the United States Court of Appeals for the Second Circuit in the case of the Accumulator Company against the Edison Electric Illuminating company and the Electric Storage Battery company by Judge Wallace, affirming the decision of Judge Lacombe enjoining the Edison Electric Illuminating company of New York from using the chloride battery, on the ground that it is an infringement on the Swan reissue patent.

W. W. Gibbs, president of the Electric Storage Battery company of Philadelphia, has made the following statement concerning the position of his company in the present litigation:

The day following the opinion of the court upon the application of the counsel for the Edison company, the court gave leave to file an application for rehearing to be submitted in printed form and accompanied with a printed argument in support thereof, and denied the motion of the counsel for the Accumulator company for the mandate, holding that in abeyance until the decision was given upon the petition for a rehearing. The decision in no way affects the business of the Electric Storage Battery company, but applies solely to the New York Edison contract, and even if affirmed will only delay that work until May next, when the Swan patent expires.

## Electrical Communication in Warfare.

General Greely, chief of the signal service, in his annual report to the secretary of war, makes interesting reference to the use of the telephone in warfare, with especial reference to the contest now in progress in the East. "All late wars," he says, "and especially the one now waging between Japan and China, indicate that electrical connections are indispensable to the success of any army operating on a base apart from the general telegraphic system. Appreciating this fact, the work of the signal corps for the last few years has been given to experimental work in the equipment of its flying telegraph lines, so that it may be ready for any possible emergency, and the system is so arranged that it looks to performing temporary telephonic service, whether between headquarters of a regiment and separate companies, or an army and its different divisions, and whether such operations pertain to garrison, camp or actual conflict."

General Greely records the marvelous success which has resulted from experiments in the army with the single uninsulated bimetallic wire lying on the ground in wet grass, when a whispered conversation was conducted through telephones half a mile apart. When the wire was partially buried the telephone could not be held close to the ear without discomfort. As showing the danger of reducing appropriations for the signal corps, he cites the significant instance in the current accounts of the present Corean war, where it was mentioned incidentally that the day following the battle of Ping-Yang the Japanese signal and telegraph corps ran into that city a flying telegraph line, extending from Seoul, a distance of seventy miles. The experiences of the army of the United States last year showed that several military departments had to be stripped of their signal sergeants and telegraph material to enable a similar length of line to be constructed in the valley of the Rio Grande.

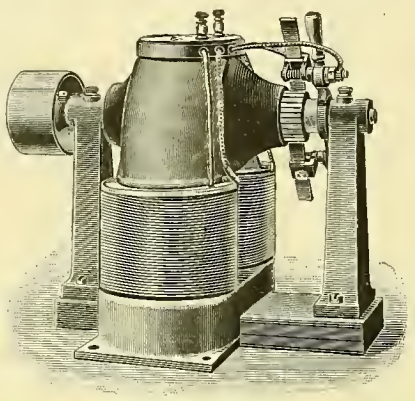
The signal corps is already experimenting with a great military balloon which has had many successful ascensions, and General Greely's corps "has endeavored to keep advised as to practical advances in the construction of dirigible balloons and aeroplanes, but nothing has developed during the year that points to the speedy solution of air navigation. The experiences of last year," he says, "prove that the utility of the captive balloon is not confined to the open country, but on occasions it may be of supreme importance in connection with operations in the great cities. The great modern city, with its solid blocks of compact buildings extending for many miles, presents unusual facilities for speedy and undisturbed change of base on the part of bodies of lawless and riotous men engaged in committing depredations and in destroying property. The extreme difficulty of overcoming riotous bodies within the limits of a large city was strikingly exemplified in Paris by the Commune insurrection, where for weeks an inferior body of ill-disciplined and poorly equipped men successfully resisted the most determined efforts of a superior force of regulars. Within the last year the troops of our own army, called upon to assist the civil authorities, found themselves marching miles of distance to repress riotous proceedings while the body of men sought for had accomplished its end and was already moving undisturbed and unobserved to another objective point. Under such conditions the operations of a captive balloon provided with electric and telephonic connection with the commanding general offer an unequaled means of observing and instantly reporting the movements of the hostile rioters, who would thus be under the surveillance of the commanding general, enabling him to act with promptness and effect.

## A Curious Accident.

Brooklyn leads the country in furnishing queer trolley car accidents. The New York *Sun* gives this account of one that startled people on November 14th:

Three manholes over the subways of the Municipal Electric Light company in Bedford avenue, at Grand, South First and South Second streets, Williamsburg, blew out yesterday afternoon, and several persons were injured. So great was the shock that some persons thought an earthquake had occurred. Many panes of glass were broken. One of the live trolley wires of the Grand Street and Calvary Cemetery railroad broke about 25 feet east of Bedford avenue, on Grand street. The end of the live wire which fell to the street twisted all over the wet roadway, and clouds of steam and smoke curled into the air. The damp earth and stones absorbed the whole power of the electric current and there were explosions from three manholes. It is surmised that gas from a defective main leaked into the electric light conduit, and the voltage from the broken wire, conveyed through the wet ground, touched the gas off.

On Grand street, about twenty feet from a manhole, John Haslor, who was driving a wagon for Grocer F. Begeman, was found lying face down in the street. He



THE ROTH & ECK DYNAMO.

was stunned. The horse he had been driving broke loose from the shafts and ran nearly two blocks before it was caught. Two other men were thrown out of a light wagon near the corner of Bedford avenue and South First street. They were only slightly bruised, and, after assisting their horse to rise, they drove away. Haslor was taken to the Eastern District Hospital. He suffered chiefly from shock.

The Bedford avenue police station is one block from Grand street and Bedford avenue. When the explosion occured the policemen on reserve thought the building was going to collapse and some of them ran into the street.

A telephone message was sent to the power house of the Brooklyn City railroad at Division and Kent avenues, and the power was shut off. Many of the electric wires on the trolley poles in Bedford avenue and in Grand street were burned out, and it was fully an hour before the trolley service was resumed.

## The Roth & Eck Dynamo.

The accompanying cut illustrates a dynamo manufactured by Roth & Eck, Chicago. The machines are mechanically and magnetically symmetrical; sparking at the commutator under all changes of load is thereby obviated. The armature is made of thin soft iron discs, separated by thin layers of paper, and is mounted on a steel shaft. Great care is taken in winding the armature to secure perfect insulation and mechanical firmness, and it is carefully balanced to avoid jarring when the machine is running. The depth of the winding on the armature is small to avoid self-induction. The commutators are made of hard copper insulated throughout with mica. The field magnets are large and of the simplest horse shoe-type, with cylindrical cores of soft wrought iron. The wire of the fields is wound on separate spools. The winding is thus easily replaced, and spools can be furnished for any voltage if a change should be desired.

Both Mr. Roth and Mr. Eck are practical electricians of long experience, fully competent to execute all work undertaken by them. They make dynamos from 8 to 75 lights and power motors from ⅛ to 7 horse power and do repair work. They have manufactured and sold over five hundred machines during the last summer. Roth & Eck are represented in the Northwest by the Northwest Engineering company, St. Paul, Minn.

## Bate Refrigerating Case.

The Bate Refrigerating case, in which so much interest has been manifested by the electrical fraternity, was set down for argument before the Supreme Court of the United States on November 19th. A Washington correspondent gives the following interesting summary of this now celebrated litigation and the connection it bears to the telephone and incandescent lighting interests:

The Bell Telephone company, under the disguise of a little concern with a refrigerating patent, is fighting desperately before the last court for fourteen years more of life, for fourteen years more of $3,000,000 annual profits. And wearing the colors of the butcher, Sulzberger, stand the lawyers of those who are trying to destroy the monopoly and wrest from it for themselves, and, in a purely incidental manner for the people, a part of its enormous gains. The principle at stake in this case that has been almost concluded without public attention is far-reaching and involves not only the enormous interests that are fighting the battle, but also scores of immensely profitable patents, millions of dollars in royalties that will exist or will not exist according as this battle goes.

The principle is this: Does a patent right, granted in the United States, expire with the expiration of the foreign patent of shortest term, granted before the United States patent is applied for, or does it expire with the foreign patent of shortest term, granted after the United States patent is granted? If the first proposition is true, then the Bell Telephone company may go on with its monopoly until 1909, the General Electric company has several years of monopoly in the Edison incandescent lamp, the rubber trust has many more years of profit in its most valuable patents, scores of business establishments will lose the suits that have been brought against them and hundreds of companies that have given up their royalties because they thought their patents had expired will enter claims against hundreds of companies now doing business in what they think is security. If the second proposition is true the Bell Telephone company's monopoly is at an end. On the same manner the position of all the others interested is exactly reversed. That is the matter the Supreme Court will decide when it decides whether Sulzberger's meat was legally or illegally frozen. The only law that bears directly upon this matter is the following paragraph from section 4,887 of the Revised Statutes of the United States:

"No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid by reason of its having been first patented in a foreign country, unless this same has been introduced into public use in the United States for more than two years previous to the application. But every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than seventeen years."

When the first foreign patent of this Bate Refrigerating company expired a number of people at once began to use its process in part, because it was supposed that under the law quoted above, and interpreted by many decisions of the lower United States court, the United States patent had expired also. The Bate company began suit against several of these people on the ground that the expiring foreign patent had not been granted before, but after, the United States was applied for, and was, therefore, not within the meaning of the law.

The Bate Refrigerating company began suit against Ferdinand Sulzberger, a butcher, for using a part of their process and refusing to pay royalty. When the case appeared in the United States Circuit Court in New York, it attracted no attention, although eminent, high-priced counsel appeared fighting for the Bate company. Poor Sulzberger had no lawyer that was any way a match for these powerful persons, who excited his wonder not a little. He could not understand how the Bate company could afford such good lawyers. But the United States Circuit Court upheld Sulzberger, deciding as it had decided about ten times before on the same point. The Bate company, undismayed by its defeat, carried the case into the Court of Appeals. It came to a hearing there last spring and was argued at length by James C. Carter.

A lawyer for the Westinghouse Electric & Manufacturing company heard about Carter being in the case and at once smelled a mouse. He began to nose around, and he soon made up his mind that some powerful monopoly was in the fight. He at once jumped to the conclusion that the powerful monopoly was the General Electric company, which, if the decision of the Circuit Court were reversed, would have the profits of the Edison lamp until 1897 instead of having to give them up, under the standing decision, on November 17, 1894. So this lawyer jumped to the rescue of Mr. Sulzberger. With part of the secret out the whole business was exposed. Everybody was soon on the qui vive and the unequal battle became a contest of evenly matched battalions of the heaviest sort. But so skillfully was the monopoly behind the Bate company disguised that the allies of Sulzberger did not suspect the right person until about the time the case was closed in the Court of Appeals. Then it came out that the Bell Telephone company was bearing the brunt of the battle. When the case passed out of the court of appeals, which did not pass upon it, but merely certified it to the Supreme Court, the interests and the counsel arrayed, as nearly as can be got at, were as follows: Behind the Bate Refrigerating company, James C. Carter and J. J. Storrow for the Bell Telephone company, Charles E. Mitchell for the General Electric company and B. F. Lee for the rubber trust; behind Sulzberger, that is for the anti-monopoly side, were Wheeler H. Peckham, Edwin Wetmore, General Benjamin H. Bristow and Charles A. Aldrich. These gentlemen represented a score of interests, notably among them the Westinghouse Electric & Manufacturing company, the United States company and the Harrison International Telephone company.

The Bell interest in this matter is the heaviest. The chief Bell patents, those upon which they mainly rely for

their monopoly, are patents on a transmitter granted to Edison May 30, 1892. He applied for this patent in the spring of 1877, and soon after the application was filed he sold his rights to the Bell company for a comparatively small sum. In that same mysterious way in which the Berliner-Bell company applications were juggled along in the Patent Office, this application was also juggled along until May 30, 1892. Of course, everyone understands that the right to use a patent exclusively begins when the application is filed, and the legal life of the patent, seventeen years at most, does not begin until the application is granted. So the longer one can put off the granting of a patent after he has the application in all right, the longer one can enjoy the fruits of its exclusive privileges. Now, if this particular patent had been granted soon after the application was filed, it would have expired at the end of seventeen years from some time late in the summer of 1877, that is, in 1894. But it was not granted, as seen, until 1892.

The Bell company had enjoyed its cheaply bought monopoly for 15 years, and then, by the formal granting of a patent, it entered upon 17 years more of enjoyment of its enormous profits; that is, other things not interfering, the transmitter would be a Bell monopoly until May, 1909. But—and here is where the trouble begins—in 1877, shortly after applying for the patent on this transmitter, the Bell company got a patent on it in England. Now, this English life expired in 1893 and at once various telephone companies sprang up in this country and began to use the transmitter, saying that under the law quoted above the patent was at an end.

But now come Messrs. Carter and Storrow for the Bell Telephone company and they have quite a different reading of the law. The main point of their contention is this: "To what does the word 'previously' in the statute refer? Why, we think it means 'previously to the filing of the application in the United States.'" This is the point they will try to make in arguing the case and it is worth millions.

## Reponsibility for Fires by Lightning.

Following is a summary of an interesting case recently decided in the Supreme Court of Wisconsin—Jackson against the Wisconsin Telephone company:

A telephone company negligently left a wire connecting plaintiff's building with another, about 25 feet high, on which there was also a pole 25 feet high, situated on a plateau 90 feet above the surrounding country. Plaintiff's building was burned by reason of a stroke of lightning striking the pole on the other building and being conducted along the wire to his. A finding that the leaving of the wire between the two buildings was the proximate cause of the fire was proper, since, it being a matter of common knowledge that lightning is apt to strike elevated points, it was not "improbable" that lightning would strike the building.

In the opinion of Judge Winslow, the court says, it is, however, argued that it is entirely improbable, if not well-nigh impossible, that a bolt of lightning striking the barn would be conducted by a telephone wire over a span of 300 feet to another building, at least in sufficient quantity to fire the second building. This raises a scientific question, necessarily depending largely upon the opinions of expert witnesses. A considerable number of such witnesses were examined on both sides. The experts called by the plaintiff testified that if the loose end of the wire was left resting on the roof of the barn, and the roof and sides were wet with rain, the wire and wet barn would form a relatively good conductor of electricity; that such a wire would carry sufficient electricity to start a fire, and would form, under the circumstances, a good path to the ground; that a part, at least, of the bolt would probably follow this path to the ground; and that all these facts have been known for years, and the danger to the barn resulting therefrom was reasonably to be anticipated. On the other hand, an equal number of experts upon the other side were of the opinion that it would be very improbable, if not impossible, for such a wire, under the circumstances, to carry sufficient lightning to set the barn on fire, and that the lightning would undoubtedly seek some shorter path to the earth. We cannot undertake to compare and decide which class of experts were the best qualified to speak authoritatively upon this scientific question. They all qualified themselves so as to make their testimony admissible as expert evidence. Nor can we undertake to decide this question of science ourselves. It was properly a question for the jury after having heard the circumstances of the case and the opinions of the experts, and we cannot say that the jury have decided wrongly upon the question.

The further argument is made that the stroke of lightning was the "act of God," for which no one is responsible. Certainly a stroke of lightning is an "act of God;" but that is not the question here presented, or, rather, another element, that is, the negligence of man, is added to the question, which materially alters its scope. If I, owning a high mast or building, which I know is so situated as to be very likely to be struck by lightning, construct an attractive path for the lightning to my neighbor's roof, so that his house is destroyed by a bolt which strikes my mast or building, shall I escape liability for my negligent or wrongful act by pleading that the lightning was the act of God? Certainly not. I invited the stroke of one of the most destructive powers of nature, and negligently turned its course to my neighbor's property. The lightning stroke is in no greater degree the act of God than the usual freshets occurring in a river. Our conclusion is that the court properly refused to grant a nonsuit, and also properly refused to direct a verdict for the defendant.

In the recent fire which occurred in Newburyport, Mass., the works of the Newburyport Car company were totally destroyed. There were two buildings, and the loss was about $19,000. Six unfinished cars, valued at $3,000, stock and fittings valued at $5,000 and machinery at $2,500 were destroyed. The company, it is announced, will not rebuild at once. The loss was covered by insurance.

## Operations of the Harrison Telephone Company.

According to the *Chicago Evening Post* the Harrison Telephone company has decided to invade the territory now occupied by the Chicago Telephone company and make an active warfare in the West. The *Evening Post* says:

The Harrison International company has not yet made much of an impression on the general public, but in the combination that is behind it are such men as W. R. McMillan, president of the Philadelphia Traction company, who made $5,000,000 in Standard Oil; P. A. B. Widener, the Philadelphia multi-millionaire; George Elkins, his partner; Stephen B. Elkins, Harrison's secretary of war and a politician and financier of national fame; William C. Whitney, the right arm of the first Cleveland administration; R. C. Kerens, the St. Louis financier and railroad man; Patrick Egan of New York, formerly United States minister to Chile; John R. McLean, the rich and aggressive editor of the *Cincinnati Enquirer*. Henry Villard was in the combination at the outset, and his money is said to still "talk."

There is also a construction company composed of the same men, and it will equip exchanges throughout the West. Of this concern the same paper says:

The plans for invading the Bell telephone field are all-comprehensive. Already 152 exchanges are in operation throughout the West. The investment thus far gone into makes the backers want to put on more steam. They have already established a strong foothold in Ohio, Indiana and Illinois, the territory heretofore covered by the Central Union Telephone company of this city, which operates under state rights obtained from the parent company. The Central Union is capitalized for $10,000,000, on which it pays dividends at the rate of 5 per cent. Everything above that amount goes to the Bell company of Massachusetts.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, November 17.—As announced in this correspondence last week, the public hearings of the Rapid Transit Commission on Tuesday and Wednesday were devoted to receiving suggestions as to route only. The subject of the construction and operation of the underground system, which is of more immediate, practical interest to the electrical fraternity, was touched upon only incidentally.

At Tuesday's meeting ex-Mayor Hewitt was present by invitation, and gave the commissioners the benefit of his views. In discussing the possibility of a line through Madison avenue, Mr. Hewitt said that he believed the legislative prohibition against building there could be removed. "I do not believe that it would be difficult to get permission again to build there," he said. "The Legislature is not going to stand in the way of rapid transit. Underground roads can be so built and operated as not to disturb the people living along the line of the streets they occupy. I have been in all the underground roads of the world, and there is no objection to those in use which cannot be overcome by modern engineering. Nearly all of these objections are caused by the use of steam locomotives. There are plenty of other methods for operating such roads."

Mr. Hewitt went into a description of a loo which he believed should be built from the city hall all around the lower part of the city, connecting with all the down-town ferries, with trains running around it in opposite directions for the distribution of passengers. There were no engineering difficulties, he said, and he favored a subway line. A road up the East Side to the Grand street district he thought not necessary. The surface cars could do the distributing to and from a trunk line to that district. On the extreme West Side he suggested a combination with the New York Central and Hudson River road for the service over that company's existing lines from Thirty-third street up.

Whatever system was built, he said, must not be rented out in parts to be operated by separate contractors. The consolidation of the elevated roads had been both a necessity and an advantage.

"The idea of operation which I have in mind," Mr. Hewitt explained, "is a consolidation of all the roads—the rapid transit system which you are to build, the surface roads and the elevated roads. It would seem to me to be one of your first duties to provide for some terms for transfers for the whole of such a system. I have no interest in any of these roads. I believe that you will have no trouble in arranging for these transfers. If it were to be done it would have a great effect upon your ideas of routes for the rapid transit lines. In such a case you would perhaps have no need to go above the Grand Central Station on the East Side, nor to build a West Side route.

"Nobody in this city ever had so much power intrusted to them for good or to produce so much lasting harm as you have. Do not allow yourselves to be driven. Go slow."

Mr. Hewitt said later that he had come to the conclusion that a rapid transit system must be underground, below Fourteenth street, and perhaps above. Every difficulty with this, he said, had been removed, except its cost.

At Wednesday's meeting Edmond Kelly appeared to represent the Reno four-tracked, double-decked system of tunnel construction. He took issue with Mr. Hewitt regarding the value of a belt loop around the lower part of the city, with the main line ending at the city hall. He favored Broadway and a double-decked four-tracked road. Under the present plan of the commissioners of a four-track road under Broadway, with all the tracks upon a level, he said, the road would disturb the side sewers and invade the vaults under the sidewalks in places. Mr. Kelly was asked: "Going down deeper, as you would have to, would it not make the danger greater to big building?" To this he replied: "It would be less. If you make the shallow-wide tunnel it cannot be done by driving a shield through the ground. It must be done by piling. By our plan you can build by driving a circular or square shield, and there will be no danger."

Finally the chief engineer of the commission, Mr. Parsons, was asked to report at the next meeting regarding all the sewers in Broadway, and to furnish such information as he might be able regarding the objections to the present plan of construction, and also as to the objections to a double-decked plan of construction, and to obtain estimates of the cost of the construction of a railroad upon the present plan, both with limitations as to opening the surface of the street and without such limitations. Mr. Parsons was also asked to obtain estimates of the cost of a double-decked tunnel both with surface openings on the street at certain specified places, and with openings at every place where making them might lessen the cost of construction, and that he make such other suggestions and furnish such other information upon the foregoing subjects as he might deem desirable.

The *Sun*, which has been an unremitting opponent to the scheme of municipal construction, is out in a long editorial callin upon the commissioners to surrender their commissions into the hands of Mayor Strong, so that the work may be done by the city Department of Public Works. It is safe to say, however, that this advice will not be heeded.

W. F. O.

## Northwestern Notations.

MINNEAPOLIS, November 17.—Telephone projects are numerous. W. S. Willis will establish a telephone exchange in Austin, Minn., at once. For several months negotiations have been pending with the Bell Telephone company to establish telephone connection from Dubuque to Farley, Luxemburg and Bankston, Ia., some eight or nine miles, but these fell through as the Bell company demanded $100 per mile for poles and wire. M. A. Duggan of Tivoli and others have formed a stock company and will build the line. Minneapolis men are canvassing Winona, Minn., with a view to putting in a new telephone system if sufficient subscribers can be obtained. Steps are being taken to connect Watertown and Delano, Minn., with Minneapolis and St. Paul by telephone. The Minnesota Harrison Telephone company has filed articles of incorporation with $250,000 capital stock. The officers are: Chas. H. Macy, president; W. A. Edwards, vice-president; B. U. Taylor, secretary, and Thos. F. Hurley, treasurer.

Wm. J. Martin, chief electrician of the Western Union Telegraph company, with headquarters at San Francisco, was interviewed in Minneapolis on the matter of building a cable to Australia or Hawaii. He thinks it will be much better to let the British government build it, as it needs the line for political purposes and would be willing to pay for it, while the income would not make it a paying investment for an American company.

The University of Minnesota football team has introduced an innovation by using electric lights to light the grounds in order to practice at night. Burtis & Howard put in the lights, and the scheme seems to be a success.

The American District Telegraph & Telephone company of West Superior, Wis., has filed articles of incorporation. The officers are: President, A. J. Graham; vice-president, W. C. Brooks; secretary and treasurer, Myron Reed. M.

## Milwaukee, Wis.

MILWAUKEE, November 17.—Vice-president Payne of the Milwaukee Street Railway company has succeeded in preventing, for the present at least, the passage by the Common council of an ordinance fixing the fare during early evening and early morning hours at four cents. The company stopped the sale of twenty-five commutation tickets for $1 at the time that the city officials raised the assessment of the street railway property to something like $3,000,000, and now that the court has knocked out the assessment it is claimed that the company ought to restore cheap fares, especially for the workingmen. At the meeting of the council railroad committee Mr. Payne made a statement and persuaded the committee to postpone action on the measure. Mr. Payne, speaking to the committee, said:

The Milwaukee Street Railway company has never earned,

nor has it ever paid, any dividend or return upon its capital stock, nor has it ever earned the interest upon its bonds. It has already defaulted twice upon the interest upon its bonds, and will default upon such interest falling due December 1, 1894.

It actually costs the company more than four cents to carry any passenger upon its lines. It would seem to me that no further argument would be needed to establish the injustice of any legislation to reduce the company's rate of fare to four cents.

In no place in this country that I am aware of are the people so well accommodated, and transporeation for so great a distance afforded for five cents, as in Milwaukee. By the provisions of our franchises we are not compelled to make transfers to or from any of the lines save the Chestnut street line, and yet the company has extended the transfer system to nearly all parts of the city, and but for adverse action on the part of the public authorities, we should have long since extended the transfer system to such parts of our lines where it does not now obtain.

I know of no other city where passengers are carried from an extreme point at the city limits at the north to the other extreme of the city limits at the south for one fare. In all cases, so far as I know, the termination of the car routes is made at the center of the city.

The establishment of the system of transfers and the method of running our cars as stated has been made by the company of its own free will and accord. That it curtails the revenues of the company to a very great extent, no one can deny, but it has been our policy to provide the very best service possible, and the desire of the management is to further extend transfer and other privileges if we could feel any reasonable certainty of being exempt from burdensome and unjust legislation and taxation.

The revenues of the company are very little, if any, more than sufficient to maintain the property of the company in such condition as to give to the people of the city the present efficient and convenient service. If a reduced rate of fare is put in effect upon our lines, it will not only throw the company within a short period of time into the hands of a receiver, but will so far take away its revenues as to compel the most rigid economy in every direction, and must necessarily reduce the car equipment and service to a relative standard approaching that of the old mule times.

We have been greatly disappointed in that the cost of operating our lines by electricity has so very greatly increased the cost of operation and maintenance. In fact, our expenses have been greater during the last twelve months than the entire receipts of the street railways were three years ago. We have expended on the streets of the city during the last year $58,927, all of which has not added one cent to the earning capacity of the property, and has relieved the taxpayers of the city of just that much expense in maintaining the streets where our lines run.

There is no way which I am able to discover in which the company would be able to make up the loss incident to the reduction of fare except doing away with the transfer system, terminating the operation of the several lines in the center of the city, and in all possible ways curtailing expenditures. I am sure this is not for the best interests of Milwaukee.

It seems to me that every citizen must be proud of the very complete and efficient street railway system which we have. The action of the public authorities in cutting down the fare below five cents, which is the universally accepted and established rate all over the United States, with very few exceptions, would give our city a very unenviable reputation in money centers and make it extremely difficult to interest capitalists in any enterprises located in Milwaukee.

I had hoped and expected during the present year to make certain extensions of our lines into the suburbs, which would have been of great convenience to the public and of material advantage to the property through which the lines would have run, but I was unable to obtain the necessary capital to enable us to do so, by reason of hostile action of certain public officials who proposed to add heavy burdens to the company, and also by reason of threatened legislation bearing upon the matter now under consideration.

My purpose has been to point out the great hardship and injustice it would be to this company to compel it to reduce its rate of fare. I cannot, however, refrain from suggesting that the principle of law is well established that any regulation or ordinance of the character of the one under consideration must provide for giving to the company a sufficient revenue to pay its proper operating expenses, to maintain it to a proper standard, and to provide for legitimate depreciation and a reasonable return upon the money invested, and that an ordinance that would not produce these results would be inoperative and void.

We should regret exceedingly to be compelled to resist any ordinance of the city, and trust that the wisdom and discretion of the council will be so exercised as to avoid such an issue.

In the United States District Court for the Eastern District of Wisconsin the Edison Light company has begun suit against the Hinkle Manufacturing company, W. G. Hinkle, Horace M. Wadleigh, Theodore A. Pamperin, George Beyer, Julius P. Grannert, Wallace P. Cook and William Harmon, who have factories at Oconto and Stevens Point. The ground of the suit is infringement, and Judge Seaman has granted a temporary injunction. The patent alleged to have been infringed is that by which so many electric companies have been involved in infringement suits by the Edison company and is described as "a certain and useful improvement in electric lamps," granted Thomas A. Edison in 1880 and numbered 223,898. The complainant alleges that there are 13,000,000 incandescent lamps in America bearing the improvements specified in the patents and manufactured by it. In addition there are, it is alleged about 1,000,000 lamps in use which were made by the defendant company. An injunction and an accounting are prayed for.

Perhaps the most interesting portion of the suit is contained in an affidavit of James G. Nolen of Chicago, which is attached to the complaint. It states that the affiant has for several years been engaged in the manufacture and sale of incandescent lamps; and among the many electric companies represented by him were the Empire Electric company and the Electric Manufacturing company of Oconto in particular. In the spring of 1894, affiant alleges, a combination was effected between the Electric Manufacturing company and the Empire Electric company whereby a practical union of the business and interests was effected and the appliances and machinery constituting the plant of the Empire company were removed from Chicago to Oconto, to be used in connection with the plant of the Electric Manufacturing company. The Empire plant was removed to Oconto about April 20, 1894, and the business of manufacturing lamps was undertaken with the plant formerly used by the Electric Manufacturing company and which was enjoined, but a short time ago, from the manufacture of lamps by Judge Seaman, and in which he was upheld by the Court of Appeals.

Subsequently, affiant states, another plant was established at Stevens Point by the same persons. "The manufacture of lamps at Oconto," affiant states, "has been carried on since this consolidation at times with some secrecy, the factory being operated at night and closed in the daytime. Mr. Hinkle has spoken of his manufacturing business to me sometimes facetiously, as 'moonshining.' He told me that there had been spotters at Oconto frequently to investigate what he was doing, but he had discovered them." Judge Seaman has restrained the defendants from continuing the manufacture of the lamps pending litigation.

The agitation for the purchase by the city of the street railway system of the city has been abandoned. The matter was submitted to the city attorney and he has given a decision to the effect that the city had no right to go into the street railway business. Even if it had had the right, the city could not have done anything of the kind, as it did not have the money and was without the means of raising it. This outcome of the agitation was not unexpected. There were many, indeed, who were of the opinion that the aldermen who began the agitation were actuated by a desire to further certain political interests and that they themselves never expected that anything would come of it. The city attorney, by the way, has decided that the city lighting scheme does not come under the same rule, so that if the city may not run street cars it may have its own electric lighting plant if it wants it.

After the street railway convention at Atlanta, General Manager Wyman of the Milwaukee Street Railway company made a tour of inspection in the East. He declares that the electric railway system of Milwaukee compares very favorably with those of the cities that he visited. Most of the eastern lines, he says, have been equipped since the Milwaukee lines were built and the cost has been fully 50 per cent. less than the cost in this city. In the eastern cities, with the new equipment, the lines are operated with 25 per cent. less power, and the new equipment requires 15 per cent. less repairing and weighs 25 per cent. less than the old equipment.

The Merrill Railway & Lighting company is erecting a storage battery and motor house at a cost of about $10,000.

The ramshackle cars of the vestibuled pattern which used to be run on the Hinsey line have been rebuilt by the Milwaukee Street Railway company under the direction of Superintendent Lynn and are now being used on the Farwell avenue line, the aristocratic line of the city. They are probably the most attractive cars in Milwaukee and are supplied with a number of improvements, including a lever switch and an appliance by which the conductor can turn off the current.

The Baraboo Electric company has bought some lots with the intention of putting in a plant as soon as that city is ready to use electric lights.

Testimony in an interesting electric light litigation has been taken in Racine. It is the suit of W. K. Freeman against the Thomson-Houston, Westinghouse and other companies. The invention in dispute is what is called the transformer system of electric lighting. Mr. Freeman went to Racine on 1878 and was continually experimenting with electric lights. In 1879 he gave an exhibition of arc and incandescent lighting, it is said, and he now claims that these lights were his own. He sues for what he declares are his rights and if he wins it means a fortune. C.

## PERSONAL.

Charles R. Barnes, city electrician of Rochester, N. Y., was in Chicago last week.

H. C. Adams of New York was in Chicago last week. Mr. Adams is making a western tour, visiting the patrons of the Phillips Insulating Wire company of Pawtucket, R. I.

Foree Bain, one of the best known electricians of the West, is again making his headquarters in Chicago, after a twenty months' stay in Duluth, Minn. Mr. Bain's numerous friends in this city are congratulating themselves and him upon his reappearance among them.

## NEW INCORPORATIONS.

Universal Electric Construction company, Detroit, Mich.; capital stock, $25,000; James H. Talbot, Detroit, Mich.

People's Electric company, Valparaiso, Ind.; capital stock, $30,000; to supply electricity for light and power; Geo. M. Nillis, Valparaiso, Ind.

Mount Vernon & Walhonding Electric Railway company, Mount Vernon, O.; capital stock, $50,000; to construct and operate an electric railroad.

Jasper County Electric Railway company, Carthage, Mo.; capital stock, $50,000; to build and operate an electric railway; John W. Halliburton, Carthage, Mo.

Citizens' Electric Light & Power company, Terre Haute, Ind.; capital stock, $50,000; to supply electricity for light and power; Russell B. Harrison, Terre Haute, Ind.

North American Interior Telephone company, Baltimore, Md.; capital stock, $60,000; to manufacture telephones and electrical supplies; Frederick W. Schultz, Baltimore, Md.

## ELECTRIC LIGHTING.

The electric light scheme for Port Huron, Mich., was defeated by the voters by nearly 400 majority.

The Edison Electric Light company's plant at Hackensack, N. J., was recently burned; loss, $30,000.

It is reported that all the electric light and railway companies of Toledo, O., are to be consolidated with the backing of the General Electric company.

The Edison Electric Light company of Columbus, O., has erected a new steel stack 150 feet high and ten feet in diameter. It is the largest stack in the city, and 70 tons of steel plate was used.

The stockholders of the Commonwealth Electric company of Camden, N. J., will meet on November 26th to consider the advisability of dissolving the corporation, as recommended by the directors.

The management of the Palace Hotel at San Francisco, Cal., has contracted with the Edison Light & Power company to furnish 8,000 lights. The power plant has been taken out and a new one will be put in.

The board of control and warden of the State House of Correction at Ionia, Mich., recommend an appropriation of $12,000 for a new electric light plant in the institution. This is badly needed to replace the gas and kerosene lamps.

The fire in the electric light plant at Portland, Me., caused damage of less than $1,000 to the building, but all the machinery was deluged with water so that the loss will be $50,000, it is said, and perhaps more. The company gives out an estimate of the loss as about $100,000.

The Middletown, O., Electric & Power company has been voted a franchise to establish a plant in that place. It had already been awarded the contract for lighting the town for the next ten years. Before it could go into business it was necessary to obtain a franchise by a vote of the people. There were 1,276 votes for it and 816 against it. Work on the new plant will be begun at once, and it is promised that the new light will be in operation by Christmas.

A new incandescent lighting plant is to be placed in the large building of the Chicago Athletic club on Michigan avenue. The Chicago Edison company will supply three 65 kilowatt 125 volt dynamos of the marine type, to be belted to three Ideal engines of 90 horse power each. These machines will be the first of exactly this type to be seen in Chicago, but are in use on a number of United States warships. They have four poles and are operated at 650 revolutions. Current will be supplied to 2,400 lamps, connected on the three-wire convertible system.

At the election held on November 6th two municipal propositions were submitted to the voters of Kalamazoo, Mich. One, authorizing the city council to construct an electric lighting plant, was carried—yeas, 1,878; nays, 1,397. The other proposition was to authorize the city council to borrow $40,000 to be used in constructing such a plant, or for the purpose of lighting the city with electric lights or otherwise, through a contract, and this proposition also carried—yeas, 1,868; nays, 1,419. Chauncey Strong is the city clerk.

## ELECTRIC RAILWAYS.

It is proposed to operate the down-town Dearborn street line of the North Chicago Street Railroad company by the Johnson underground system.

An electric railway will be built between Benwood and Moundsville, W. Va., a distance of eight miles, at a cost of $300,000. Wareham & Hughes of Beaver Falls, Pa., secured the contract.

The Thirty-ninth street line of the Chicago City Railway company, from Cottage Grove avenue to the Union Stock Yards, is now operated by electrical power. The next electric line to be opened will be the Auburn Park line. This will be ready within 20 days. It will run from Sixty-first street and State to Seventy-ninth and Halsted.

A press dispatch from Williamsport, Pa., gives the information that on November 10th, the management of the Vallamont Traction company's system was formally taken over by Manager E. H. Davis of the Lycoming Improvement company. This company now has under its direct management the Williamsport Passenger Railway company, the Lycoming Electric company, the East End Passenger Railway company and the Vallamont Traction company.

The Southside railway will also be turned over to the same management after it has been opened for travel.

The electric railway to the peak of Snowdon in Wales, which has so much been spoken of, is now beginning to take shape. A company has been registered under the name of the Hotels & Railway company of North Wales with a capital of £6,000 in 600 shares of £10 each, to construct a railway from Llanberis, Carnarvon, to a point near the summit of Snowdon, and to erect and carry on a hotel at or near the summit.

A Grand Rapids, Mich., dispatch to the *Chicago Herald* says: "The council of Mackinac village has granted John H. Roberts of this city a franchise for an electric road to follow the shore line around the island, the road to be built ready for operation next spring. The road as planned will be elevated, and the cars will hang suspended from a single rail. The franchise includes an electric lighting plant to light cottages, hotels and streets."

The certificate of the Chicago North Side Electric Street Railway company proposing to increase the stock $1,000,000 has been filed for record. The certificate includes the resolution of the North Side Electric Street Railway company adopted at a meeting of the company November 13, 1894, to increase the capital stock from $500,000 to $1,500,000. The proposition was adopted by the stockholders by the affirmative vote representing 4,499 shares of the stock of the corporation, this being two-thirds of all the votes represented by the whole stock of that corporation.

The Philadelphia & Rosemont Electric Railway company is acquiring a right of way from Philadelphia to Bridgeport via Bryn Mawr, Ardmore and Gulf Mills and other villages in Upper Merion. The company is to conduct a high-speed line, and promises to land Bridgeport passengers at Fourth and Market streets, Philadelphia, in a half hour, the fare for the round trip to be less than 50 cents. In view of the intention to maintain a speed of 35 miles an hour, as permitted in the charter, the company will avoid public highways as much as possible, and construct its road principally through fields. It has already acquired a right of way over farms from Bridgeport and Gulf Mills.

The sale of the Tiffin Consolidated & Interurban Railway company's electric lines, including two lines of street railway in Tiffin and the line between Tiffin and Fostoria, which is almost completed, has been made to a company of eastern capitalists. B. L. Cook of Chicago and Major Turner of New York conducted the negotiations. The company's unsold bonds, many of which have been put up as collateral security, are being collected, and it is probable that the property will be transferred within the next week, after which haste will be made to complete and put in operation the Fostoria line.

According to the *Philadelphia Ledger*, the reduction of fares on the trolley lines to Germantown from 10 to 5 cents, with the privilege of free transfers, represents probably the cheapest car service to be had anywhere. The rival traction companies—the People's and the Philadelphia—which run cars to Germantown, have many roads in their respective systems, and their lines reach to almost every section of the city. The length of the People's Line from Snyder avenue to Pelham (Germantown) is very nearly ten miles (9.92), and one can ride from end to end for 5 cents, or at the rate of two miles for a cent. More important than the length of the ride is the transfer privilege, by which one may be carried for a single fare from Germantown to almost any section of the city.

At the first annual meeting of the Electric Traction company of Philadelphia it was shown that during the year ended June 30th the company's systems carried 41,040,346 passengers, and the receipts were $1,916,936.77. The total expenditures were $1,823,562.82; leaving a balance of $93,373.95. The report also showed that $2,016,723.07 had been expended during the year in equipping the various lines with the trolley system. The operation of the company's lines by electricity, it was predicted, would soon show heavy reductions in the expense account, and greater returns than were at first hoped for. This showing is practically without any of the results of electricity as a motive power; the only electric cars which the company had in operation on June 30th last were those on Tenth and Eleventh streets, which had been in operation one month, with the effect of increasing the traffic 47½ per cent.

## TELEPHONE.

A new telephone company has recently been organized in Dayton, O., to install the D'Unger telephone. The company has already secured over 400 subscribers, and expects to put in over 1,000 telephones within a short time.

The Wilkesbarre, Pa., Telephone company is placing all trunk line wires underground. The new building on North Fell street is nearly completed and will be ready for occupancy about February 1st. It will be devoted entirely to the purposes of a telephone exchange.

The stockholders of the American Bell Telephone company held a special meeting in Boston on November 15th, and voted to increase the company's capital stock from $20,000,000 to $20,500,000, under the act of authorization passed by the last Massachusetts Legislature. The act provides that the stock shall be disposed of at auction. Five hundred shares of the stock will be issued, and the commissioner of corporations will be asked to set the price per share. Then the stockholders will be offered the stock at the price named by the commissioner, they having the first choice as to purchase. The act provides that all shares unsubscribed for by the stockholders within a certain prescribed time shall be sold by the directors of the company at auction.

## TELEGRAPH.

A dispatch from Los Angeles, Cal., dated November 14th says: In the United States Circuit Court the case of the Mercantile Trust company versus the Atlantic and Pacific Railroad company has been argued by counsel and submitted. This is the suit in which the Postal Telegraph-cable company is closely concerned and in which the Western Union Telegraph company, through counsel, moved compelling the receivers appointed in the cause to honor the supersedeas claimed to have been made and to stay all proceedings under the decree in favor of the Postal Telegraph company until the final hearing of the appeal taken by the company in intervention. It is further asked that until such final hearing and determination of the appeal the court should refrain from granting any of the relief desired and prayed for in the petition of the Postal Telegraph-cable company.

## MISCELLANEOUS.

The General Electric company has advertised plans and specifications for two new buildings to add to the plant in Schenectady. The contract will be awarded at once for the erection of the structures. These new buildings will be a storehouse, 350 by 52 feet, and a laboratory.

The earliest passenger boat propelled by electricity is believed to have been that of Prof. Jacobi of St. Petersburg, Russia. In 1838, on the river Neva, he had such a boat. It was 28 feet long, 7 feet wide, and carried 14 persons. The electric motor was operated by means of 320 Daniell cells. The earliest passenger car propelled by electricity is believed to have been that of Alexander Davidson of Edinburg. It was in operation in October, 1842, and is described in the Edinburg *Evening Journal* of that period.

A dam on the Gould Creek, at Cobden, Ont., gave way on the 10th ult., says the *Canadian Engineer* for November, carrying away the electric power house and sweeping it for nearly a mile into Muskrat Lake, dropping the machinery out on the way. The night watchman, James Garneau, was in the building at the time of the accident, and had a miraculous escape. He did not get out of the flood till he was carried into deep water two miles from the dam. He was considerably bruised by stray timber and had one knee dislocated. The dam had only been completed a couple of days and belonged to Alex. McLaren, who intended to supply light to the town.

A suit has been filed in the United States Circuit Court at Pittsburg by John E. Ridall against the McKeesport Light company and the Brush Electric company of Cleveland, Ohio, to recover $100,000 in commissions. Ridall claims that he and Eugene Ingold had a contract with the Brush company by which they were to be agents in Allegheny and nineteen surrounding counties in western Pennsylvania. He says that although the Brush company's patents were valid, they allowed infringements on them and permitted other companies to manufacture and sell electrical goods in his territory. He also claims that the McKeesport Light company has purchased from other parties and is using a large number of double carbon arc lamps which are infringements on Brush patents. Thus Ridall and Ingold have lost in commissions and compensations over $100,000, and they ask an accounting of all profits in their territory and a payment of the commissions which they claim are due them.

A Pittsburg dispatch dated November 10th says: A bill in equity was filed here to-day by Richard S. Waring against George Westinghouse Jr., asking that Westinghouse be compelled to explain what has become of 10,000 shares of stock in the Standard Underground Cable company, which stock Mr. Waring alleges belongs to him. The par value is $1,000,000. Waring owned a patent on the manufacture and insulation of electric wires and cables. The Standard Underground Cable company had a capital stock of $3,000,000, divided into 30,000 shares. Waring owned 20,750 shares. In 1886 Westinghouse took 5,000 shares, and Waring said he was induced to place 10,000 shares in the name and control of Westinghouse that he might become president of the company. For this stock Waring says he has received no compensation or accounting. He says Mr. Westinghouse has sold the stock and kept the proceeds. Mr. Westinghouse says his answer to the bill will show the untruth of Waring's statement.

It is reported that a successful test was made recently on the Reading railroad, in the presence of a number of prominent railroad men of Philadelphia and Buffalo, of the new audible electric block signal, which it is proposed to introduce on that road. As the "feelers" of the engine passed over the block plates, the approach of a similar train more than two miles away, hidden by a curve in a deep cut, was indicated by the electric gong in the cab of the engine, and in about 3½ minutes the train came in sight. After it had passed, the presence of an open switch was indicated, also the fact of danger from an overhanging end of a car partly on a siding and from an iron wire laid across the tracks. As this device works automatically and sounds a gong by the ear of the engineer, there is little chance of an accident arising from defective or impeded vision, or inattention on the part of engineers or firemen. The cost of equipping a road is said to be about $200 per mile, and the expense of signal towers and switch tower men is saved.

A new coin-controlled gas meter has been devised in Europe which calls electricity to aid in gas consumption. As described by *The Gas World* the action depends not upon a complicated arrangement of wheels and levers, but upon a simple electro-magnet. A coin dropped into the slot closes the circuit of an electrice battery; the magnet is excited and attracts its armature, and the movement of the latter is made to open the valve of the meter. A number of coins, the number depending upon the length of the slot, may be inserted at one time; and, by means of a simple escapement movement, when one coin's equivalent in gas has been consumed, that coin is relieved and another made to take its place. As long as the stream of coins is maintained the meter will continue to supply gas. While this is the position the battery circuit is open; it is only when the gas has been cut off for want of coins that the electro-magnet is required—to again effect the opening of the valve. Consequently, the battery need be called upon only at rare intervals, and may therefore be expected to have a long life. There is really no mechanism in the contrivance; and it is as compact as it is simple. It will be understood that the consumer has to do nothing but insert coins; the escapement does what more is required.

## TRADE NEWS.

The office of the New England agency of the Westinghouse Electric & Manufacturing company, formerly located at 620 Atlantic avenue, Boston, Mass., has been removed to the Exchange building, 53 State street, Boston.

Word has been received from Stanley Green, western manager of the Fuel Economizer company of Matteawan, N. Y., to the effect that his company has been awarded the diploma of honor at the Antwerp exposition in competition with several other economizers. The only other economizer mentioned obtained only a silver medal. Mr. Green, since commencing his business in the West a year or so ago, has been remarkably successful in the introduction of the Green economizer and has been receiving of late some very handsome testimonials, which go to show that there will come a time when an electric light or power station built without a fuel economizer will be behind the times. One of the best testimonials received by Mr. Green was from the South Chicago Street Railway company. O. S. Gaither, secretary of this company says that by a comparison of 15 days' service without and 15 days service with the use of the Green economizer in connection with Stirling boilers and natural draft, the saving effected when using the economizer amounts to over 15 per cent. of fuel oil consumed. Such letters as these should make it easy to place economizers in the plants of thinking electric light and power men.

## BUSINESS.

The Washington Electric company, Chicago, states that there has been an unusual demand for its well-known rheostat and stage dimmer. Some of its recent orders come from nearly half the states in the union.

The New England Electrolytic Copper company, at Central Falls, R. I., has just completed an addition to its works, which is made entirely of iron and steel furnished by the Berlin Iron Bridge company of East Berlin, Conn.

Alfred M. Walter, formerly connected with the electrical engineering department of the World's Fair, has opened an office at 857 Rookery, Chicago, and is prepared to furnish telephone equipments and private electric light, power and heating plants.

The Electric Appliance company is making a special drive at present on C. E. M. jack-knife and motor switches, offering them at greatly reduced prices and displaying a very extensive stock. The C. E. M. switch is one of the first jack-knife switches on the market having the spring catch to hold the jaw open or closed and thus give it a quick and positive action. This switch is well known and popular.

The western office of R. Thomas & Sons has been moved from 142 Lake street to 1532 Monadnock building, Chicago, and the business in the western territory will be handled by the Bryant Electric company through Grier Bros., managers of the western office. J. E. Way, former western manager for R. Thomas & Sons, is now located in New York city and has general charge of the sales department of the R. Thomas & Sons company.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued November 13, 1894.*

528,924. Radiating and Supply System for Thermo-electric Generators. H. B. Cox, Hartford, Conn. Application filed February 17, 1894.

This invention provides for the employment of a liquid cooling and radiating medium for maintaining the surfaces of the generator at a different temperature. A further object of the invention is to provide an improved method of maintaining the liquid cooling medium comparatively cool and of renewing it.

528,925. Electrical Transformer. Frank S. Culver, Eau Claire, Wis. Application filed December 19, 1893.

The principal features of this invention are: a casing supporting the coil and its core, a non-conducting diaphragm plate having the contacts of the primary wires attached to it, non-conducting contact blocks having contacts united by fuse wires and adapted to engage removably with the contacts on the diaphragm plate, and a door hinged in the bottom of the casing and adapted to support the blocks and secured by a screw knob.

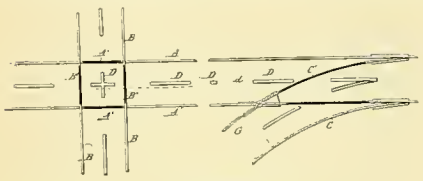
528,959. Intersecting Electric Railway Tracks. Mark Lowd, Salem, Mass. Application filed February 10, 1894.

The cut is a diagrammatical view of a portion of a street railway crossing and turnout, embodying the invention, in which A are the rails of an ordinary railway track, which are crossed

by the rails *B*, extending at right angles thereto, and forming part of another track. *C* are the rails of a turnout from the main line rails *A*. *D* are disconnected surface conductors adapted to be successively and intermittently energized in any suitable way by an electric current when a car passes over them, the car being provided with suitable current-collecting devices. These current collectors bear on the conductors *D*, the spaces *d* between the ends of the conductors and the distance between the current collectors being so proportioned that when one collector is over a space *d* the other collector will be in contact with one of the conductors *D*. As the car moves along the track the forward collector will first come into engagement with the section of conductor *D*, and then the rear brush will be engaged, so that, in this manner, there will always be a connection between one of the conductors *D* and the motor terminal on the car, the other terminal of the motor being in connection with the rails *A* through the car axles and wheels, the rails *A* forming the return circuit, as is usual in constructions of this kind.

528,960. Self-winding Electric Clock. Adam Lungen, New York, N. Y. Application filed May 13, 1893.

In this clock there is a combination consisting of an electro-magnet, an electric circuit, a vibrating armature, a notched wheel engaged and moved by the armature, a circuit-closing lever also engaging with the notched wheel, the armature engaging the circuit-closing lever and lifting it out of engagement with the wheel before it engages and moves the wheel itself.



NO. 528,959.

528,963. Underground Conduit for Electric Roads. E. A. Mathers, Romeoville, Ill. Application filed June 12, 1894.

A slotted conduit having double sides forming air spaces opening into the slot on each side, a flexible plug fitting the slot, and adapted to be lifted for a portion of its length from the slot by the passage of a trolley bar, and to close behind the trolley bar as it passes, pipes adapted to convey compressed air and communicating with air spaces, and mechanism operated by the lifting of the plug to permit the compressed air to flow from the pipes into the air spaces as the plug is lifted are the features of the invention.

528,972. Ore Washer or Concentrator. Charles F. Pike, Philadelphia, Pa. Application filed April 6, 1894.

In the separation of gold from the black sand in placer gravel it is very difficult to exhaust the sand by suction from the receiving vessel, owing to the high specific gravity of sand, so that a powerful suction is necessary that is liable to carry off the lighter particles of precious metal with the sand. The object of this invention is to provide means whereby the black sand is practically held in a state of suspension at the inlet of the suction discharge instead of allowing it to subside after having passed out of the magnetic field between the feed and suction discharge. This is accomplished by subjecting the sand to the influence of a magnetic field in the immediate vicinity of the inlet of the suction discharge. It is obvious that by holding the black sand in suspension at the inlet of the suction discharge a comparatively small or minimum suction force will take the sand out of the receiving vessel while a very great or maximum suction force would be required if the sand were left to subside after having passed out of reach of the magnetic field between the feed and suction discharge.

528,997. Signal Replacer. William R. Sykes, Jr., and John P. O'Donnell, London, Eng. Application filed November 27, 1892.

Railway signals are replaced automatically or otherwise, from a distance by this arrangement.

529,000. Automatic Fire Alarm System. Henry S. Tunnard, Rugby, and Arthur M. Keays, London, Eng. Application filed February 8, 1894.

A sensitive thermostat is employed to operate an automatic fire alarm system, by which the presence of fire is audibly indicated, first, in the room or landing or immediate locality in which the fire takes place; secondly, in the hall or central position which is set apart conveniently for inspection by indicators which show the exact spot or room in which the fire has broken out; thirdly, outside the house in a convenient position, over the door or on a gate post, or wherever desirable, by means of ringing a gong or its equivalent; and, fourthly, in the fire station itself on a gong, and by an indicator showing the street or the street and house if desired, in which the fire has broken out.

529,058. Trolley Wire Hanger. Johan M. Anderson, Boston, Mass. Application filed July 19, 1894.

This device is employed to suspend the trolley wire from beneath bridges and like structures extended over the roadway, and comprises an insulator to which the trolley wire is secured, a socket for the reception of the insulator, and in which the insulator is capable of being turned or rotated, a protective sleeve on the insulator, and a locking device engaging the sleeve to retain the insulator in its adjusted position within the socket.

529,059. Electrical Apparatus for Controlling Signals. S. S. Bogart, Schraalenburg, N. J., and Michael B. Leonard, Richmond, Va. Application filed December 11, 1893.

This is a railway signaling system comprising a main line connecting two or more stations, a local signal circuit at each station electrically connected with the main line, and including a normally grounded polarized relay adapted to respond to a current of one polarity only passing over the line from the battery at the distant station; electrical devices and connections at each station, adapted when in normal position to connect the terminals of the main line to ground through the battery, and permit telegraphing without affecting the relay; devices including a reversing switch adapted to shift the ground connections of the main line terminals so as to throw the battery at the approximate station into circuit with the relay at the distant station and cause a current of an opposite polarity to that used for telegraphing to pass over the line to the distant relay, and thereby release the distant signal.

529,080. Ore Washer or Concentrator. C. F. Pike, Philadelphia, Pa. Application filed April 6, 1894.

Both the metal particles and the black sand are separated from the waste matter of the ore and saved without the aid of mercury or amalgam plates. If desired, however, the black sand particles may be discharged when the requirements of service make it unnecessary to save the same.

529,085. Electro-magnetic Machine. Gordon J. Scott, Philadelphia, Pa. Application filed June 12, 1894.

This invention is a self-starting, single phase, non-synchronous motor. If there be arranged on opposite sides of a closed conducting ring *A*, as illustrated in the cut, two coils *B* and *B'* wound to generate opposite poles on opposite sides of the ring *A*, and an alternating current be supplied to the coils *B B'*, the poles generated will tend to induce in the ring *A*, in its opposite halves, opposed currents in the direction of its circumferential length. The full line arrows in the diagram may be taken as indicating the direction of flow at a given instant. If now means be provided, as, for instance, collectors *C A'* in contact with the ring with their ends connected to afford a closed or other circuit for the flow of the currents induced in the ring *A*, there will be a continued flow through the ring as long as the coils *B B'* are supplied with alternating currents. Such magnetic poles will be formed with such action and reaction upon each other that if the reference to the poles at points displaced from the neutral plane to produce a distorted field, as indicated for instance in the diagram, and the ring *A* be free to turn on its axis, it will tend to go into a symmetrical position by turning in the direction of the dotted arrow, and as such motion will only magnetically bring a fresh part of the ring into position, while keeping the poles stationary, a continued torque is obtained. In applying the invention to practice for the construction of alternating current motors for power purposes, the inducing coils and the closed ring are to be provided with laminated iron cores, but for some purposes, as in the case of a meter, an iron core for the closed ring *A* is not essential.

529,117. Regulator for Dynamo-electric Machines. Jules Ferrand, Darnetal, France. Application filed July 3, 1891.

This arrangement is intended for the automatic regulation of electrical generators for multiple arc distribution, and to automatically compensate for variations in the number of translating devices, such as lamps in circuit and variations in the speed of the generator. In the cut *K* represents a base plate, to which is secured a standard *I* and oil or dash-pot cylinder *F*. In the upper part of the standard *I* is secured a regulating electro-magnet *D*, and on one side of this standard is pivoted a regulating lever composed of three integral or connected arms *E'*, *E²*, *E³*, the upward extending arm *E'* serving as an armature for the electro-magnet *D* and the outwardly extending arm *E²* having pivoted thereto at its outer end a rod connecting with a piston *L* in the oil cylinder *F*. This arm *E²* also supports a counterbalance *P*. The piston *L* is perforated with a hole, the cross-sections of which are increased or diminished by means of a screw *O*. Upon the base *K* are secured in any desired manner supports or arms provided with insulated bearings for a casing or frame carrying a column of carbon plates *A*. One end of this carbon column is adapted to bear or rest against a regulating screw *B* turning in a threaded nut or opening on the support for the carbon column. The other end of the carbon column bears or rests against a rod *r*, the outer end of which is threaded, as shown at *H*, the threaded portion passing through a threaded opening in the lower end of the lever arm *E³* and adjustable therein by means of ordinary thumb-screws as shown. The current which it is desired to maintain continually in the main line is first predetermined, and the screw *B* is adjusted to the proper point to produce the required field magnet strength. The exciting current passes from the dynamo to and through the carbon column and lever arm back to the dynamo, as shown at *N N'*. From the main circuit there is a shunt circuit *M M'* leading to and through the electro-magnet *D*, thus energizing it. When the current passing through the carbon column is maintaining the current required in the main line, the electro-magnet *D* will have a magnetic force dependent on the strength of the derived current and the construction of its coil. Under these circumstances the magnetic force of the electro-magnet *D* will maintain the armature lever *E'* in a position of equilibrium corresponding to the predetermined pressure on the carbon column in the exciting circuit.

529,127. Binding Post for Electric Instruments. Ernest A. Lowe, New York, N. Y. Application filed February 9, 1894.

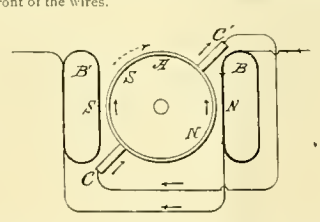
This device is especially adapted for testing purposes.

529,144. Automatic Set-back Annunciator. H. C. Thomson and George J. Galbraith, Boston, Mass. Application filed July 2, 1894.

An index finger, after indicating any desired point or figure, is automatically returned to position by a lift operated by electricity instead of by hand.

529,145. Dynamo-electric Machine. René Thury, Geneva, Switzerland. Application filed August 18, 1894.

This machine is composed of two superposed horizontal and fixed rings of U-shaped section, each provided with a coil and with a circular pole-piece, on which are disposed suitable wires in combination with a vertical axis bearing a bell, the inner wall of which is provided with suitable ranges of teeth disposed in front of the wires.




NO. 529,085.

529,152. Electrical Transformer. Fritz Zickerman, Berlin, Germany. Application filed December 9, 1892.

A feature of construction is the arrangement by which the current transforming capacity may be altered without changing the potential of the current from the source of energy, the potential of the current from the secondary terminals, or the translative relation of its elements.

529,165. Train Operated Signaling System. J. H. Frischen, Berlin, Germany. Application filed November 28, 1893.

The peculiarity of this device consists in the fact that the rail contacts are not in direct communication with the signal devices, but all the rail contacts are so connected with a switching apparatus that, when run over by an engine or train, the switch device is actuated for a brief space of time and comes to rest thereafter when the train has passed the rail depression contact.

529,174. Magnetic Telephone. Oliver Higgins, Napoleon, O. Application filed July 16, 1894.

In this instrument the receiver and transmitter are combined in a single case. When the receiver is in proper position at the ear the transmitter is in position in front of the mouth. There is an adjustment by which the field of the magnet is regulated.

529,199. Method of and Apparatus for Circulating Liquid Electrolytes. Paul Schoop, Zurich, Switzerland. Application filed December 29, 1893.

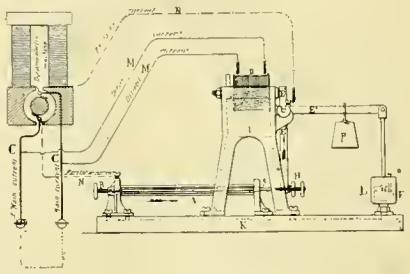
To maintain the fluid electrolyte at a practically constant composition a circulation of the liquid is required in a definite direction throughout the vessel, such as from the top to the bottom and thence to the top again.

529,203. Telephone. John Serdinko, San Antonio, Tex. Application filed April 28, 1894.

The receiving and transmitting instrument receives its magnetism from the magnets of the magneto call.

529,212. Automatic Electric Cut-out. Daniel F. Sweet, Grand Rapids, Mich. Application filed June 9, 1894.

In this device there are an electro-magnet in the circuit, an armature carrying an arm, a roller journaled in the arm, a spring-pressed bearing edge normally bearing on the periphery of the roller, means for adjusting the roller so as to cause the edge to bear on the roller nearer to or farther from a line through the pivotal centers of the roller and armature, a lar carrying one of the contacts, a latch holding the contacts in engagement, and means for disengaging the latch by the movement of the armature.



NO. 529,117.

529,213 Electrical Cut-out. Daniel F. Sweet, Grand Rapids, Mich. Application filed June 9, 1894.

The objects of the invention are to prevent destructive discharges at the contact plates when the circuit is broken, and also to render the instrument more delicate in its adjustment.

529,216. Conduit for Electric Conductors. James Tatham, Philadelphia, Pa. Application filed March 17, 1894.

A flexible conduit for electric conductors is made by first making a tube of lead or other ductile metal, then applying an insulating covering, and then forming an outer tube of lead or other ductile metal around the insulating covering.

529,240. Electric Arc Lamp. James Brockie, London, Eng. Application filed June 19, 1894.

A single regulating mechanism serves to control the movements of two pairs of carbons, one of which burns for a certain time, and is then extinguished, the other pair then burning for a like time, and so on alternately. Both pairs of carbons thus become consumed by equal or approximately equal stages, the lamp continuing to operate as long as if it had a single pair of carbons of length equal to that of the two pairs added together.

529,263. Apparatus for Extracting Gold. James B. Hannay, Loch Long, Scotland.

A vessel is provided at its bottom with an insulating lining, a carbon zone embedded in this lining and connected with the positive terminal of an electric generator, a mercury cup in the bottom of the vessel connected with the negative terminal of the generator, a rotary agitator journaled in bearings in the bottom of the vessel, and the valved outlet pipes arranged at different levels.

529,265. Means and Apparatus for Distributing Electricity. H. T. Harrison, London, Eng. Application filed January 19, 1894.

A combined direct low tension and alternating high tension transformer system of electrical distribution is employed, comprising primary and secondary mains a transformer, direct low tension and alternating high tension current generators, a switching device for throwing generators alternately in and out of circuit with primary mains, and an automatically operating switch and circuit connections whereby the transformer will be rendered inoperative on the secondary mains, and the primary and secondary mains will be connected together when the primary mains are connected with the direct current generator, and will be thrown into action and be maintained in action when the primary mains are disconnected from the direct current generator and connected with the alternate current generator.

529,272. Alternating Current Electro-dynamic Machine. Maurice Hutin, Paris, and Maurice Leblanc, Le Rainey, France. Application filed August 20, 1892.

It is proposed to synchronize alternating current dynamo machines, and while the invention is particularly adapted for alternating current motors, it is also applicable to alternating current generators.

529,297. Stopping Apparatus for Engines. N. E. Nash, Westerly, R. I. Application filed April 25, 1894.

Means are provided whereby the driving steam engine or hydraulic motor, in factory or shop, may be stopped from any one of a number of stations situated in different parts of the building in case of accident to persons engaged in the establishment or to the machinery.

529,300. Autographic Telegraph. John O'Neil, New York, N. Y. Application filed November 27, 1893.

The message to be transmitted is written or otherwise provided in non conducting ink or other substance upon a conducting transmitting sheet, so that the interruption of the electric current through the sheet by the non-conducting characters thereon may, through suitable agencies, produce corresponding characters upon a receiving sheet provided at the opposite end of the telegraphic line.

529,313. Electric Gas Lighter. Charles G. Savage, Philadelphia, Pa. Application filed June 13, 1894.

This fixture will not spark on the return movement, and will not short-circuit in the event of the lever catching on the contact of the burner.

529,325. Electro-magnet. Carl C. Gerlach, Cleveland, O. Application filed December 9, 1893.

This invention is described as a magnet coil consisting in a series of coils of wire, the surface of which is partially wound with flexible non-conducting material in such a manner as to present alternately the covered and bare wire, and to admit an insulating medium between the strands.

# Western Electrician.

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## Electrical Production of Ozone for the Treatment of Disease.

Since its discovery ozone has been the object of experiment by a number of eminent scientists, who have succeeded in demonstrating its value as the most powerful oxydizer known, opening up for the chemist possibilities which in time may result in many important changes in chemical technology. Sanitarians and medical men have been watching with interest the results of these experiments, published by many scientific institutions, confirming as they do, beyond a doubt, what was set forth by the first exponents of ozone—Schönbein, Andrews, Houzean and others—that ozone is an absolute germicide and an arrester of putrefaction. A number of eminent physicians, both in this country and in Europe, have experimented with ozone in therapeutical treatment of lung and throat diseases, and the results obtained have been very satisfactory. Dr. W. J. Morton in New York and Dr. E. P. Murdock in Chicago have, in different medical journals, reported a number of cases treated by ozone, for phthisis, bronchitis, catarrh, etc., with marked benefit.

The principal reasons why ozone has not heretofore gained a recognized place as a therapeutic agent are the difficulties in obtaining it, the imperfections of existing ozone apparatus and the question of expense. These obstacles, however, are largely overcome by the Fahrig electrostatic process of producing ozone (described in the WESTERN ELECTRICIAN of August 27, 1892), and the honor of establishing the first ozone treatment institute is due to Chicago.

Gustave Monrath, a Chicago electrical engineer, has been for several years a close student of the phenomena of ozone, and he coöperated with Professor Fahrig in perfecting the latter's system, in which the ozone is produced by the passage through the oxygen of the air of the disruptive spark of a high potential discharge of alternating current. During the last year Mr. Monrath has experimented with an ozone plant to be adapted specially for medical use in sanitariums and hospitals. The necessity of having a medical adviser as to the strength of ozone necessary, its different methods of application, etc., brought him in contact with Dr. E. P. Murdock of Chicago, who had a wide experience in clinical experimentation with ozone.

The result of this connection was that Mr. Monrath laid his plan before the Pathological society of Chicago, which received it very favorably, and expressed a desire to see the plant put to a practical test during a longer period. In compliance with this wish, Mr. Monrath erected a temporary plant at his residence and placed it at the disposal of the physicians of the Pathological society, Dr. Murdock undertaking the supervision of the treatments. During the last six months this plant was in operation 43 cases of tuberculosis, bronchitis, asthma and catarrh were treated, and the result was so satisfactory that a company was organized to establish a permanent institute for ozone treatments in the heart of the city. The accompanying illustration gives a view of the apparatus and treatment room of this sanitarium, which is located in the Champlain building. The institute has a suite of tastefully furnished rooms occupying one-half of the east front of the fifteenth floor of the building.

In the apparatus room, which is naturally of most interest to electrical men, there is a small direct current 110 volt Jenney motor operating a suction blower, which draws the air through a four-inch pipe extending through the ceiling up to the roof, guaranteeing a supply of as fresh and pure raw material for ozone as it is possible to obtain in Chicago. From the blower leads a pipe connecting to a drying and cleaning apparatus, serving to remove suspended matter found in the atmosphere, and also to dry the air, absorbing by chemical means whatever moisture may be contained therein. The purified air is now forced into the ozone generators. These are large mahogany cases lined with ¼ inch plate glass and connected together in series. In passing through these ozone generators the air is brought in contact with an electric discharge of high tension and frequency, previously prepared by means of a special transformer set underneath the ozone generators. Alternating current is obtained from a special 50 volt circuit controlled at the switchboard shown on the left. In the working part of the generators are several improvements on the Fahrig process which have not yet been patented, and are therefore guarded as secret.

To secure a perfect action of an electric ozone generator, it is necessary that the electric discharge be absolutely even and that the ozonization or electrification of the oxygen atoms take place throughout. No sparking or eruptive discharge should take place between the active parts, as such action would produce an oxydization of the nitrogen of the air and form nitrous acid. To guard against this, the ozone, after it leaves the generators, is blown through a solution of caustic soda, which retains whatever nitrous acid may have been formed, and the ozone, which is now pure, is led through glass pipes to the treatment table, shown in the foreground of the picture, where different outlets for inhalation through the nose or mouth are provided.

In the laboratory are different outlets for experimental purposes and for ozonizing different liquids used for spraying the throat and softening the mucous membrane. An air pump connected with the motor is used for condensing air, which is employed in atomizers and nebulizers in the application of ozonized liquids. Regulating devices for varying the strength of the ozone give the operator entire control of the generators and enable him to produce ozone from one-tenth of one per cent. volume to a complete ozonization of every atom of oxygen passed through the apparatus.

The institute is furnished with a complete outfit of apparatus for throat exploration and for microscopical examination of bacterial cultures. Mr. Monrath has spent considerable time in making experiments with the view of demonstrating the effect of ozone on different germ growths; also its effect on smaller animals, such as rabbits and mice. He has succeeded in combining ozone with different essential oils, and has demonstrated its importance as an arrester of putrefaction and as an antiseptic.

The effect of ozone inhalation on a patient is to cause profuse expectoration, clearing the throat and lungs. It lowers the temperature and increases the pulsation, showing that a vivid oxydization of the hemoglobin of the blood is taking place. When properly administered it is perfectly harmless.

ELECTRICAL PRODUCTION OF OZONE FOR THE TREATMENT OF DISEASE.

## Incandescent Lamp Litigation.

A motion was made in the United States Circuit Court last week to suspend the injunction which was granted in August last restraining the Star Electric Light company from infringing the Edison incandescent lamp patent. The motion was made by Attorney F. W. Parker, who stated on behalf of the Star company that there is now pending in the United States Supreme Court the case of the Bate Refrigerating company, upon which depends the life of a large number of valuable patents, and among them the Edison incandescent lamp patent, which, the attorney said, expired Saturday, November 17th. Judge Seaman said the court should not take any precipitate action and he would continue the motion indefinitely. In the future, if it is shown that other federal circuits have suspended the injunctions granted to the Edison company, and the manufacturers against whom injunctions still run are thereby placed at a great disadvantage, the court would take similar action.

## Electricity in Agriculture.

During the summer of 1894 a new and successful attempt was made to introduce electricity for power transmission in farming, and the result has been so satisfactory that it is worthy of wide attention.

The plant, as described in the *Elektrotechnische Zeitschrift*, was built by Ganz & Co. for the Ugarte-Lowatell estate in Moravia, and consists of a central station operated in connection with a planing mill located near the center of the estate. A direct current generator of 35 amperes capacity at 620 volts is driven by a 30 horse power engine and is furnished with an automatic tension regulator (Blathy type) which works in connection with the governor of the engine, keeping the potential of the dynamo constant in counteracting the variation of the steam pressure.

From the central station two power circuits of a total length of about six miles are operated. One of these furnishes current for a grist mill, a farm and a dairy. The other circuit supplies two separate farms. At the grist mill, which is ordinarily run by water power, the motor is used only at such time of the year when the water power is unavailable. At the dairy there is a 10 horse power motor running a centrifugal pump and different smaller appliances. At each of the farms is a 12 horse power motor mounted on a movable truck and built over to protect it against the weather, Fig. 1. This electric locomobile, so to speak, is moved from one part of the farm or field to another, wherever power is required for running threshing machines, pumps, straw-cutters, etc. Along the edge of the fields is placed the electric circuit, consisting of bare copper wires supported on glass insulators. By means of a flexible cable,

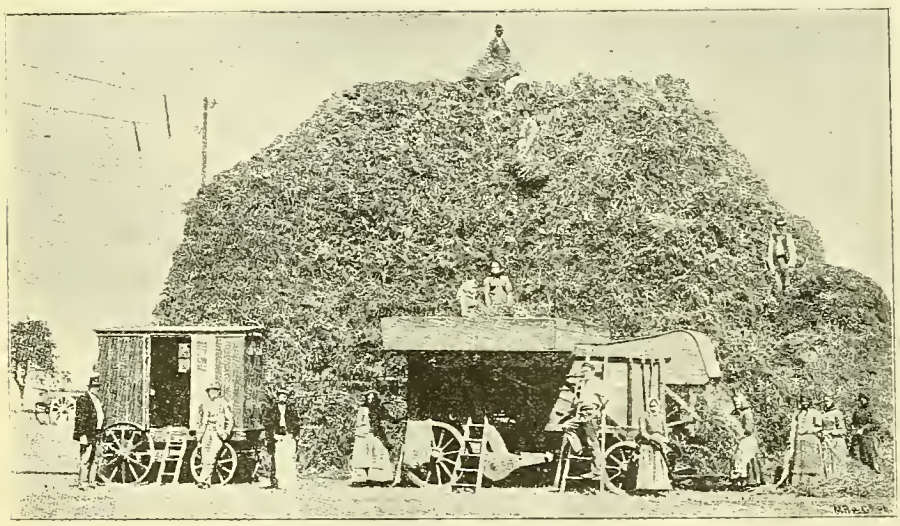


FIG. 2. ELECTRICITY IN AGRICULTURE.

with clamps to connect on the wires and hard rubber sleeves to prevent short circuiting, the motor can be connected up at any part of the field where its service is required, as shown in Fig. 2.

The consumption of current for the dairy, when the centrifugal pump and counter shafting are running, amounts to 8 amperes. The grist mill takes about the same amount of current, while the threshing machine requires from 10 to 16 amperes, according to the nature of the grain to be threshed.

The two main circuits consist of two 5½ millimeter (No. 4 B. & S.) bare copper wires, supported on glass insulators on poles. The pole line also carries a telephone circuit, which connects the central station with the different sub-stations, enabling them to be in constant communication with each other.

When, in the fall, the threshing is finished the motor cars are brought back to the farmyards and used for operating irrigation pumps. One of these movable motors is used during the winter for furnishing power for a brewery and distillery located near one of the farms.

The employment of electrical power in farm work has several advantages over the use of portable steam engines. The motor cars are considerably lighter and are easier to transport from one place to another. There is no hauling of coal and water required, and no time is lost in firing up. It also reduces the danger of setting fire to grain stacks and barns. From an economical point of view the electric transmission has proved very satisfactory, as the generator is located in the planing mill, the refuse from which reduces the coal bill.

In this country, where there are so many small coal mines, many of which are not large enough to be recognized as railroad shipping points, it is suggested that similar plants, not only for agricultural, but also for smaller industrial purposes, might prove practicable and profitable for the small manufacturers and farmers of the surrounding district, as well as for the coal miner.

## The Definition of Reactance.[1]

By Charles P. Steinmetz and Frederick Bedell.

At the Philadelphia meeting of the American Institute of Electrical Engineers, May, 1894, the name reactance was officially adopted by the Institute and defined in accordance with a paper on "Reactance" communicated by us and reprinted in most of the electrical periodicals. The action of the Institute was unanimous and its definition has met with general approval. Objection to it, however, has been raised in an article[2] recently communicated to a French periodical. Since we cannot agree with the arguments forwarded in this article, it will be in place for us to state our views thereon.

The definition of reactance adopted by the American Institute of Electrical Engineers is:

"Reactance is the component of electromotive force at right angles to the current divided by the current."

By this definition the term reactance is the quotient of the reactive electromotive force divided by the current, where the reactive electromotive force includes all wattless electromotive forces, whether due to inductance, capacity, polarization or counter electromotive force of any kind, as of synchronous motors, and excludes all energy components, as would be introduced by motors, transformers, hysteresis, etc.

In objecting to this definition, the writer referred to takes a position essentially as follows:

(1) The term reactance shall include the effects of self-induction and capacity only.

(2) It should always be defined by the equation

$$I = \frac{E}{\sqrt{R^2 + K^2}};$$

Where: I = current;
R = ohmic resistance;
E = electromotive force;
K = reactance.

(3) For harmonic currents

$$K = \omega L - \frac{1}{C\omega};$$

Where: L = self-inductance;
C = capacity.

$$\omega = \frac{2\pi}{T} = \text{pulsation}.$$

(4) The term reactance has a right to exist only because it is a constant of the circuit. Defined, however, as the quadrature component of electromotive force divided by the current, it is the complex resultant of different reactions and not a constant of the circuit. All terms in "ance" should denote constants of the circuit, and whenever used in a generalized meaning an additional term should be added, as "apparent reactance."

We may state that when investigating the question of properly defining the term reactance we have fully considered the position taken by this writer. We have, however, come to the conclusion that this definition is not tenable, but is contradictory for the following reasons:

(1) Neither in the one nor in the other definition is reactance a constant of the circuit, except in circuits containing no iron. In reality, circuits nearly always contain iron, and in such circuits the reactance can be considered as approximately constant only in a very limited range. When extended over a greater range of electromotive force or of current, the self-inductance, and thus the reactance, varies. The same applies to most of the other quantities ending in "ance," as impedance, reluctance and permeance, and thus the statement that quantities in "ance" should be constants of the circuit is against the adopted practice and not fulfilled by either definition.

(2) Where iron is present, the statement for harmonic currents

$$K = \omega L - \frac{1}{C\omega}$$

contradicts the definition of K by the equation

$$I = \frac{E}{\sqrt{R^2 + K^2}},$$

R being taken as the ohmic resistance and K as reactance. This is due to the presence of hysteresis. These relations do hold in the absence of iron, and such cases were taken by us in our paper to illustrate the definition for simple cases; the fundamental definition, however, should in our opinion be sufficiently general to include circuits with iron. Consider a harmonic current flowing in a circuit embracing iron; for simplicity assume capacity absent. The last equation would not give any direct relation between the inductance and reactance, such as would be obtained from the equation just preceding, but would make reactance still a more complex quantity by including therein not only the effect of self-induction but that of hysteresis as well. Furthermore, it would lead to the result that the reactive electromotive force is not wattless, but includes an energy component;—an idea quite foreign to the term.

These considerations obliged us to discard any indirect definition of reactance by means of the term inductance, and to adopt the more direct definition analogous to the definition of resistance.

The definition of resistance is Ohm's law:

$$R = \frac{E}{I},$$

where E and I respresent an unvarying electromotive force and current, respectively.

Considering E and I as a harmonic electromotive force and a harmonic current—or in the case of alternating quantities which are not simple harmonics, as their equivalent harmonic values; that is, values of equal square root of mean square value and equal power—the above equation gives the definition of impedance:

$$\text{Impedance} = \frac{E}{I}.$$

Our proposed definition for reactance is analogously written:

$$\text{Reactance} = \frac{\text{reactive E}}{I}.$$

Further we may define the equivalent resistance of the circuit by the expression

$$\text{Equivalent resistance} = \frac{\text{power E}}{I}.$$

In the absence of expenditure of energy outside the electric conductor, this quantity coincides with the true ohmic resistance.

These quantities are thus defined directly and in a uniform manner. How far these quantities are constants of the circuit depends upon the circumstances; in any case reactance and impedance depend upon the frequency.

The phenomena taking place in an alternating current circuit cannot fully be represented by the terms ohmic resistance, inductance and capacity; but a further term has to be introduced, representing the losses of energy outside of the electric conductor, as hysteresis, etc., and the most satisfactory way to do this appears to us to be the generalization of the term resistance to equivalent resistance.

The use of equivalent values for quantities is employed in the paper on "The Law of Hysteresis: III." In the discussion of this paper at the Philadelphia meeting the significance of these values is pointed out.

Wherever the reactance is generalized to include active counter electromotive forces, it may well be distinguished by the denotation "equivalent reactance."

We would emphasize the utility of two rectangular components, whether electromotive forces or currents are resolved. Reactance should always, in our opinion, be associated with that which represents no expenditure of energy, the reactive electromotive force being at right angles to the current and the reactive current (the wattless current) being at right angles to the electromotive force. Whether we resolve currents or electromotive forces depends upon the problem in hand; each method has its advantages. If we resolve the current, we may write:

$(\text{Current})^2 = (\text{power current})^2 + (\text{reactive current})^2$.

Divided by E, this gives:

$(\text{Admittance})^2 = (\text{conductance})^2 + (\text{susceptance})^2$,

for a simple case; in general, for conductance and susceptance we should write equivalent conductance and equivalent susceptance. Admittance, conductance and susceptance are thus used as the inverse correspondents of impedance, resistance and reactance, and may be added as vector quantities. Many alternating current problems are much simplified by this treatment. It is important, however, to employ components which are at right angles to each other, and for this reason the definition of the American Institute of Electrical Engineers seems preferable. It is in this point that the definition is fundamentally different from that of the French writer already referred to. In the absence of hysteresis losses, the definitions would be the same, applying the term equivalent reactance to the case where counter electromotive forces, other than those due to capacity and self-induction, are present. To conclude, then, we may say that in the absence of iron we may define reactance in terms of inductance and capacity, as this writer has done, and as has been done by us in the illustrative examples in our paper; the fundamental definition, however, should, in our opinion, remain in the general form adopted by the American Institute of Electrical Engineers.

In a note to our original paper we have called attention to the first suggestion of the term reactance by M. Hospitalier in May, 1893, and the recommendation of the committee appointed by the Société Internationale des Electriciens to consider the programme for the Chicago congress, 1893. The term is a happy one; it is international, and uniformity in its use is to be desired.

In our opinion the best definition for "reactance" is tha

1. Communication to the American Institute of Electrical Engineers, October 31, 1894.

2. "Apropos de la Reactance," by Prof. Andre Blondel. *L'Industrie Electrique*, September 25, 1894.

adopted by the American Institute of Electrical Engineers. In this, as in all matters, there is however room for difference of opinion. The reasons for thus defining the term have not before been published, but we believe that when they are duly considered, the action of the Institute will meet with international approval.

## The Ithaca Street Railway Plant.[1]

The Ithaca (N. Y.) street railway plant, now in full operation, is arousing considerable attention and interest, as an example of good practice in power generation. Here may be seen a result which for its accomplishment required much labor, and the calling out of skilled and experienced engineering talent. Sparing neither money nor time, the builders have succeeded in erecting a power plant which utilizes a large part of the available energy stored in the waters of Fall Creek.

A short distance below the Sibley turbines and above the Ithaca Falls the creek makes a sudden turn which is especially noticeable in the sharp angle of the north wall of the gorge, and then falls some 30 feet. This angle seemed peculiarly adapted for the location of turbines and was finally chosen as the site of the plant, work being commenced soon after. The angle was considerably widened by blasting, and was thus formed into a large niche for the insertion of the structure. The opposite and almost parallel walls of the niche were connected by a series of I beams set into the rock or on heavy masonry built up against the slightly inclined walls. These I beams, carried by a number of heavy struts of built-up steel plate, give support directly to the main floor of the plant, located on a level with the water of the creek above the fall. The main walls of the building rest partly on the I beam structure and, where possible, on foundations hewn directly out the rock. An adjoining structure of wood furnishes space for two vertical boilers.

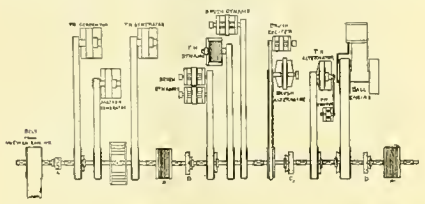
The difficulties overcome will be more apparent when it is considered that the walls of the gorge at this place rise almost perpendicularly to a height of perhaps 150 feet, and that every inch of material used was hauled to the top of the walls by a circuitous route, and then lowered into the gorge; yet so advantageous were the contracts made by the company that the installation of the entire plant did not cost over 5 per cent. more than would have been the expense of constructing it on level ground.

To obtain the water at the most favorable point, the creek was dammed immediately below the Sibley plant and its waters forced into a race, from which a flume five feet in diameter, constructed of $\frac{5}{16}$ inch steel boiler plates and supported throughout its length on solid masonry, leads to the plant 600 feet distant with a drop of 60 feet. Immediately on entering the building the flume makes a sharp turn toward the north, and at almost the center of the main floor occurs the downward turn which allows the water to fall vertically. A short distance below the penstock divides, and the water falls in a slightly oblique direction to the four turbines. Two turbines are mounted on the same shaft, and each pair is rated at 400 horse power. The water enters between the two wheels and passes outward through both, thus eliminating all axial thrust.

The water on leaving the turbines is discharged through vertical pipes, and over the end of each pipe is accurately fitted a long sleeve, which, when lowered, sets closely on a seat placed a short distance below the mouth of the pipe. The amount of water discharged is governed by raising or lowering the sleeve, this action being effected by an automatic mechanism, which may be described as follows: To one end of each projecting turbine shaft is connected by belt a controlling machine acting directly on the sleeve. When the jack-shaft on the main floor revolves too rapidly an electrical contact is made by the ordinary engine governor, ball and string arrangement. The circuit thus established magnetizes one of two oppositely located electromagnets and attracts a lever vibrating freely between the two. This attraction of the lever causes, during its continuance, the release of a pawl, which, vibrating to and fro concentrically with a toothed wheel, causes the latter to rotate in one direction. This motion is communicated by several gear wheels to a rack directly connected to the sleeve spoken of above, and lowers it, allowing a smaller quantity of water to discharge, and thus decreasing speed of turbines. Vice versa, if speed of jack-shaft is too slow the other magnet is put in operation, causing an opposite pawl to act and turn the toothed wheel in the opposite direction, with a resulting increase in discharge opening. This method of regulation has proven very successful on the lighting machine shaft, where the load is nearly constant. On the street car generator shaft, where the load varies greatly, the controlling machine, although the best of its kind in the market, seems of little value. The engineers of the plant are at present working on a new method of regulation, which, it is hoped, will prove more efficacious.

To one end of each projecting turbine shaft is firmly keyed a grooved sheave from which the power is transmitted to the main shaft by hemp rope gearing. The general arrangement is that of the Dodge system; the rope being continuous is returned to the first groove after running off the last, by a single wheel mounted on a cross head sliding in vertical guides, the pulley performing thus the further function of keeping the rope taut at all times.

The general plan of arrangement of machines on the main



ITHACA STREET RAILWAY PLANT.—PLAN OF DYNAMOS ROOM.

floor will be more readily understood by reference to the accompanying diagram. The entire power is taken from a series of jack-shafts, having the adjoining sections connected by clutches *A*, *B*, *C* and *D*. The proper support for the bearings, eleven in number, is obtained from two parallel I beams forming part of the I beam structure before mentioned in speaking of the construction of the building. *P* and *P'* represent two large grooved sheaves keyed to their respective jack-shafts and receiving the power from the corresponding turbine wheels. The pulleys to which are belted the several machines are either keyed directly or connected by friction clutches to the various sections of shaft. The two 100 kilowatt General Electric machines furnish power for the street car service. At present the current used in the dynamo laboratory is also taken from these machines, but on account of unsteadiness of current it has been decided to extend the jack-shaft beyond *P'* and connect at that point a Mather machine to be used for laboratory purposes exclusively.

The Brush and the General Electric alternators respectively furnish current for 1,200 and 2,000 incandescent lamps, while the three Brush and a Thomson-Houston machine of a capacity of 65, 30, 30 and 50 respectively, supply the arc lamps scattered through the various parts of the town. The 200 horse power simple non-condensing Ball engine and the 400 horse power compound condensing McEwen engine, in combination with a 200 horse power Root and a 200 horse power Manning upright boiler, form a complete steam plant to be used in emergencies or during low water seasons. Usually the plant burns coal only about three months annually, having at other times sufficient head of water. This time may be further reduced by the electric heating apparatus, which it is the intention to install in the near future.

From the method of connecting and arranging pulleys on jack-shafts, it is seen that any of the four prime movers may drive any one or any number of the dynamos as occasion may require, the belts of the Brush and small Thomson Houston dynamos being easily thrown off. The McEwen engine cannot be operated without driving the sheave *P* and its turbines, but steps are being taken to remedy this fault. The plant is further fitted out with five large fireproof enamel switchboards, lightning arrester, telephone connections, etc.

Prof. Carpenter has acted as mechanical engineer for the company, and has assisted the manager, H. Bergholtz, in arranging many of the details of the station. The electrical part of the station was designed by Mr. Bergholtz. H. K. Spencer, a graduate of the class of '90 (Cornell), is chief engineer.

In the construction of the plant simplicity and utility have been made the foremost considerations and both have been admirably attained, although the attendant difficulties were often great.

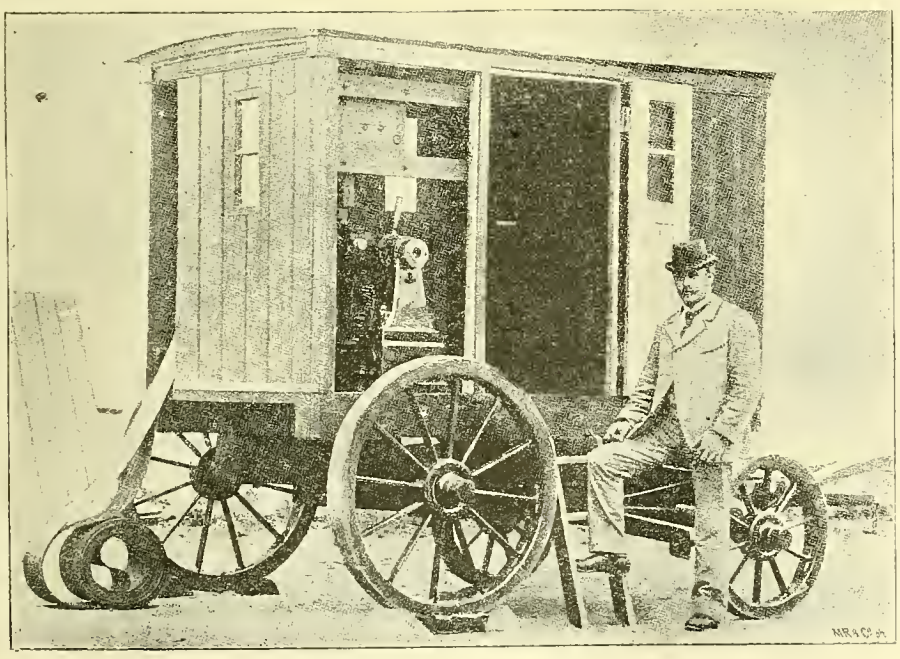


FIG. 1. ELECTRICITY IN AGRICULTURE.

1. From the *Sibley Journal of Engineering* for November.

## Suggestions for an Index of Engineering Literature.[1]

BY PROF. GEORGE D. SHEPARDSON.

It is said that at one time all existing knowledge could be obtained by one man. Indeed there is a general belief that Dante, who lived from 1265 to 1321 A. D., was the happy possessor of all that was known in civilized countries. One occasionally meets, even at the present day, individuals whose manner indicates the possession of such universal knowledge, but their claims lack official certification. It is impossible to know everything relating to even one of the many branches of learning at the present day, although the sciences are so finely subdivided.

Not many years ago it was practicable for persons of moderate incomes to take all the papers and magazines treating of engineering and allied sciences. To-day the number of periodicals is so great that one could hardly read all that is in them, or even digest all the memoirs bearing upon his own field of work, unless he devoted to it a major part of his time. He would be so busy learning what others are doing that he would have no time to do anything original himself.

Nevertheless in undertaking an investigation on any subject, whether for engineering, manufacturing or purely scientific purposes, one of the first things one should do is to look up the subject thoroughly in order to learn what others have done and are doing. One thereby avoids spending energy on problems that others have already solved, or working along lines that others have proved to be fruitless. He obtains hints as to the most promising directions in which to work and the best methods for working.

In some lines of engineering much has been crystallized, and standard text-books and manuals have been prepared, containing the essence of the best that has been written on the subject. The authors of many of the earlier manuals gave little credit to others, and left the reader with the impression that the book contained the sum of all knowledge. The abstracts in books are necessarily colored by the individual views of the editor. It is preferable to refer back to the original memoirs, especially if one wishes to obtain details of the investigations. More recently the commendable custom of continental writers is being adopted in scientific books and papers published in this country, so that this difficulty is being removed to a considerable extent. As all lines of engineering and science are developing at a rapid rate, the books are necessarily behind the times, and the live worker must read the current periodicals in order to know what is being done by others.

A common method of learning the history and present state of knowledge on a given subject is to obtain access to the files of periodicals in a library, and search the indexes of the separate volumes for articles upon the subject under investigation. Some journals of long standing have occasionally published indexes of complete files covering a number of years. Searching the various indexes volume by volume is tedious and difficult. One is apt to overlook the very papers for which he is searching, when hunting cursorily through index after index. One usually works under the disadvantage of having only incomplete files or those of only a few periodicals. After the most careful search through the material available, he still has the feeling that some other periodical not immediately accessible may contain exactly the information he seeks.

To save the time of busy people and to call attention to a mass of material that would otherwise be available to comparatively few, attempts have been made at different times to compile indices of literature. Perhaps the greatest of these is the "Royal Society Catalogue of Scientific Papers," consisting of eight quarto volumes of about 1,000 pages each. This was compiled under the auspices of the Royal Society of England and was printed by the English government at public expense. It gives alphabetical lists of titles and authors of scientific papers published in every civilized country between the years 1800 and 1873, but exclusive of technical and professional papers.

Next to this stands Poole's "Index of Current Literature," published in this country by private enterprise. The first volume, compiled with the coöperation of 52 libraries, indexed 6,200 volumes which were published during the period from 1803 to 1882, and contains about 1,000 references to articles on electrical subjects that appeared in popular and scientific journals. The second volume, to which 97 libraries contributed, covers the period from 1882 to 1887 and contains about 600 references to articles on electrical subjects. The third volume, compiled with the coöperation of 122 libraries, covers the period from 1887 to 1892 and gives about 500 references to electrical papers. The volume for 1893 gives about 100 such references. In Poole's Index there is some attempt at classification of electrical papers and there are a few cross references.

The "Descriptive Index of Current Engineering Literature," compiled from the monthly summaries in the *Journal of the Association of Engineering Societies*, gives an excellent

1. Read at the meeting of the American Institute of Electrical Engineers, November 21, 1894.

resume of engineering literature between 1884 and 1891. This is devoted principally to civil engineering, but gives about 30 pages with 700 references to electrical papers. Most of the references indicate the character of the papers. The cross references are excellent. The index in the *Journal of the Association of Engineering Societies* is commendable in that it prints the indices on only one side of the leaf so that they may be cut and re-arranged according to the ideas of the individual. The *Journal* for each December contains a summary of the monthly indices of the year.

The American Institute of Electrical Engineers published in its *Transactions* for about three years, 1886 to 1888, an excellent index of current electrical literature compiled gratuitously by a gentleman too modest to have his name appear. Volume V. of the *Transactions* contains about 5,100 references, volume VI. about 5,800, and the first few numbers of volume VII. contain about 1,500 references. Some of these are accompanied by descriptive notes.

The first volume of Galloupe's "Engineering Index," compiled and published by private enterprise, gives about 28 pages with 1,500 references to articles on electrical subjects appearing in the years 1883 to 1887. The second volume, 1888 to 1892, gives 61 pages with about 3,300 references, titles and authors being given.

Excellent indexes have appeared in the *Engineering Magazine* and in *Electrical Engineering*, the figures for which are not at hand. Recently *Electric Power* has launched out into this field. The digest of foreign literature in the *Electrical World* is commendable, but confessedly incomplete. Extended indexes are published at intervals by the French and Germans. A universal index, published weekly at Leipzig, aims to give tables of contents of a number of journals arranged in the alphabetical order of their places of publication. Doubtless there are other indices not known to the present writer.

A commendable custom of *La Lumière Électrique*, that might well be imitated by other periodicals, was to publish at intervals complete lists of articles that had previously appeared in the paper bearing upon particular subjects.

To the mind of the writer, the most ideal index yet attempted was that published at first in connection with *Electrical Engineering* and later as a too short-lived publication by itself under the name of *Electrical Literature*. The printing of the indexes on separate sheets, perforated and tied together, each sheet being devoted to a single subject, combines the advantage of flexible classification of subjects with ease of arranging the sheets from month to month so as to make the bibliography of each subject consecutive and up to date. Having the sheets loose and perforated for binding with brass clips or cords, allows each individual to supplement the printed sheet by his own notes or additional references. The publisher is also able to add sheets descriptive of later or earlier memoirs without impairing the integrity of previous work. It should be and doubtless is a matter of sincere regret by the electrical and mechanical engineering professions that this publication was forced to suspend on account of lack of financial support.

Since the available printed indexes are imperfect, many individual students feel the need of keeping private indexes. In some centers, such as universities and large cities, personal friends sometimes coöperate in maintaining a common index. Yet even in such a case one cannot escape the feeling that much of his labor is needless, since some one else may be doing the same thing better. He feels also that it is not as useful as it might be, because only he and his immediate friends have the benefit of his index, which might be of use to many if it could be made more available. Occasionally one favors his fellows by publishing his bibliography on some special subject. An excellent example is "Titles of Literature Concerning the Fixation of Free Nitrogen by Plants," contained in Bulletin No. IX. of Minnesota Botanical Studies, which gives references to over

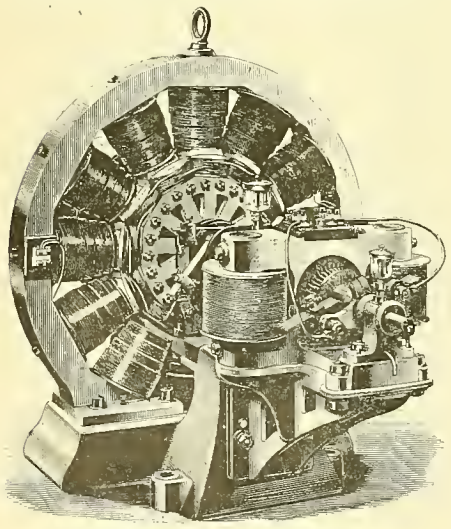


FIG. 1. DIRECTLY COUPLED ALTERNATOR AND EXCITER.

600 papers, compiled by Professor D. T. MacDougal of the University of Minnesota.

Another valuable but less extensive index was published in the *Electrical World*, vol. XII., p. 6, July 1, 1893, by J. Stanford Brown, giving about 375 references to papers on "Accumulators in Practical Work." Those who have free use of the published indexes find it desirable to supplement them by manuscript notes for several reasons. Many of the memoirs deal with more subjects than the one indicated by the title. Discussions of matters of interest are often found buried in papers having little other value, and bearing other titles. In many cases the titles given by the authors are misleading and do not indicate the true nature of the memoir. The published indexes cover only periodical literature and give little or no attention to the books which often contain valuable matter that has not found its way into the journals. In many cases books contain reprints or abstracts of papers, the originals of which are inaccessible while the books containing them may be easily procured. Some of the published indices give only bare references to the articles, while the investigator finds it desirable to obtain abstracts or outlines of papers when looking up any subject. He must therefore supplement the index with comments of his own. Some of the monthly summaries are poorly classified and it is almost as laborious to hunt up the bibliography of a subject from these as from the original periodicals. Even those that are well classified are published in sections and it is necessary to look through the index month by month to complete a search.

In view of the present state of the case, as imperfectly outlined above, what seems to be the best method of securing the publication of an index that shall avoid the failings of those already existent? One of the first considerations is that the compilation of an index which will be an improvement upon all existing ones must be the result of the coöperation of a large number of people, as was Poole's Index, to which over 122 libraries contributed. It will require the expenditure of a considerable amount of money and will probably not be self-suporting. Such work could probably be done best under the auspices of some society or societies, as was the Royal Society catalogue. Since the index might well include the subjects of interest to electrical, mechanical, hydraulic and civil engineers, it seems reasonable that the various national engineering societies might combine forces to maintain the publication of an index that would be of lasting value to the engineering profession of the entire world. Since the headquarters of four of the national societies are in the same city, two of them being in the same building, such coöperation would not seem difficult. A joint committee might be appointed which would receive the confidence and the coöperation of all. They could draw upon a large constituency for coöperation and subscriptions. The committee might outline the plan for the work, and prepare preliminary lists of subjects, which might be published and submitted to the members for suggestions. The committee could then call upon different members for contributions from their private index

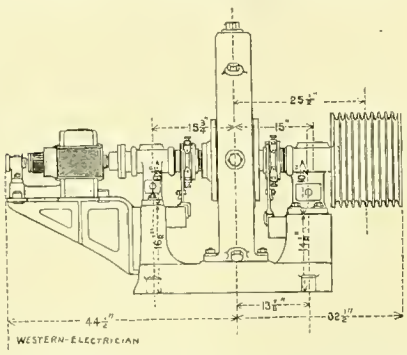



FIG. 2. DIRECTLY COUPLED ALTERNATOR AND EXCITER.

files. The committee should have authority to edit the contributions thus received. Doubtless a number of publishing houses would contribute complete files of their publications for such indexing. Indeed, some of them have already made such offers to a private enterprise for such purpose.

Incidentally the material thus received would make a valuable addition to the libraries which are being gathered at the headquarters of the societies. Such a committee could certainly compile an index that would be far in advance of the imperfect ones now published. The vast amount of duplicate labor now expended by the papers and by individuals could then be turned to more efficient work.

In conclusion the writer begs to add some suggestions as to the style of such an index. It should include subjects relating to electrical, mechanical, hydraulic and civil and perhaps mining engineering. It should index books as well as periodicals. The references should be descriptive so far as practicable. Each subject should have a page by itself. Digests and simple references might be on separate sheets. References and sheets on each subject might be numbered consecutively for convenience in adding later notes from other files or from later publications of the same articles. Abbreviations or other symbols should indicate whether the reference is to the original paper or to a reprint, whether the paper is in full or abstract, whether accompanied by discussion and by plates or illustrations. The separate sheets should be perforated for rearranging and rebinding and should be printed on one side only. It might be preferable to print the whole index on cards similar to those used in the card catalogues of libraries.

In this way it would be practicable to begin publication at an early date and to issue parts at frequent intervals. The indexes to current publications could be issued without delay, and those of completed files or historical works could appear as the work proceeded. Publishing the work in sections would allow each engineer or student to purchase or subscribe for only such subjects as were of importance or interest to him. Indeed the work, if carried out properly, would result in so massive a catalogue that few outside of libraries or other public institutions could afford to obtain the entire work.

* * * * * * *

After this paper was prepared, the writer learned, in looking over some periodicals that accumulated during the summer, that the Royal Society recognizes the defects of its admirable catalogue and is taking steps to revise and bring it down to date with the coöperation of learned societies in various parts of the world. (London *Electrician*, XXXIII., 268, July 6, 1894.)

## Directly Coupled Alternator and Exciter.

A type of alternating current dynamo having the exciter armature directly coupled to the main armature shaft is shown by the illustrations. This machine is manufactured by Mather & Platt of Manchester, England, and, at 500 revolutions, as operated at the new municipal station at Southport, England, has a capacity of 60 Board of Trade units. The potential is 2,000 volts, and the periodicity 50 per second. This dynamo has 12 poles, as shown in Fig. 1.

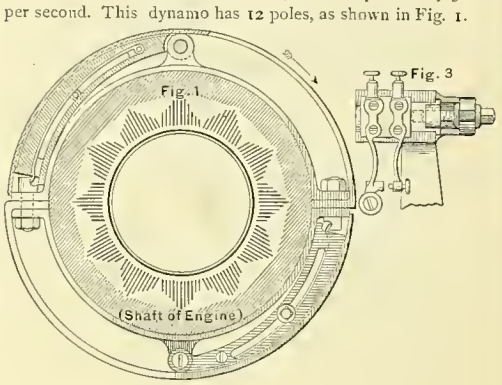



Fig. 2

FIGS. 1, 2 AND 3. ACCIDENTS IN LARGE POWER PLANTS.

A smaller machine is illustrated diagrammatically in Fig. 2, showing the sheave for rope driving. The larger generator is driven by a 100 horse power engine.

The magnets are wrought-iron, and are arranged round the armature, exterior to it, and are attached to a massive cast-iron ring, which forms the yoke connecting the limbs. The attachment is so arranged that any of the magnet cores can be removed without disturbing the remainder or taking out the armature. The armature is constructed of two plates or discs keyed on to the shaft, between which the armature cores are held by bolts, so that, as with the magnets, any section of the armature can be removed without disturbing the remainder. Apertures in the discs allow free ventilation in the interior of the armature cores.

The magnets are excited by a Manchester dynamo, which is carried on a bracket bolted to the bedplate of the alternator, the armature shafts being coupled direct. The whole arrangement is exceedingly compact, occupying little floor space. The exciter connected with the machine, shown in Fig. 1, has an output of 25 amperes at 100 volts. The exciting current required for the full load of the larger machine is 5.75 amperes. The machines require small exciting power, which results in high electrical efficiency; with full load this exceeds 97½ per cent., it is said.

It is a noteworthy point in connection with these machines that they may be short-circuited without detriment. The current passing through the armature, if absolutely short-circuited with the fields excited to their full extent, is less than double the normal output of the machine, which it is stated would not be injurious for a short time.

## Detroit's Public Lighting Plant.

Work on the city lighting plant of Detroit, Mich., is progressing rapidly, and it is thought the down-town district can be supplied with current about the first of the year. According to the *Detroit Journal* there are 162,000 feet of main line conduits within the half-mile circle, and 35,000 feet of laterals. They invade every street in the half-mile circle. There are 107,000 feet of wire in the conduits, and 28,000 feet yet to put in. Four of the seven boilers in the power house are now in place, and the brickwork is in progress. The building for offices, boilers, engines and dynamos is practically completed, and the offices will be occupied next week. The engines are being moved to the power house. The pumps and condensers are already there. The foundations for the dynamos are completed.

About 2,000 poles have been set outside the half-mile circle and about 150 miles of wire strung on them. These are principally the main lines. The main lines will require 50 miles more of wire, and the branch lines 125 or 130 miles. This work cannot be done before warm weather.

There are 280 lamp posts now in position, and 720 posts remain to set up. Each will carry one lamp. The towers will carry 550 lamps. These 1,550 lamps can be lighted by the power provided for, and there will be enough to light 700 more. The public lighting commission deemed it best to assume that Detroit will grow. Should the city ever need more than 2,200 lamps there is room in the site for doubling the boiler, engine and dynamo capacity.

At a recent meeting of the board of trustees of Vallejo, Cal., it was decided to establish a municipal electric light plant, and proposals are now invited for the lighting of the streets. The old electric light plant was destroyed by fire some weeks ago.

## Accidents in Large Power Plants.

Notwithstanding the improvements in the modern automatic and Corliss engines, and the special safety devices of many kinds to be used in connection with machinery, shafting, etc., many serious accidents have been reported of late. At the works of the Attawangan Manufacturing company, Killingly, Conn., trouble developed on the receiving shaft, and before the engineer could shut down three 10 foot pulleys had gone to pieces, and a five inch shaft was bent to an angle of 75 degrees. One wall of the engine room was knocked out and other damages sustained. A 30 foot fly-wheel, 60 inch face, burst in the factory of the Nashua Manufacturing company, Nashua, N. H. The accident was caused by a loose pin in the governor which prevented the safety device from acting. In this case the boiler house was 1,000 feet from the engine room, and the accident caused the breakage of the 18 inch steam pipe, thus turning loose in the engine room steam from 1,500 horse power boilers at a pressure of 80 pounds, with no means of shutting off steam except by going the whole distance, 1,000 feet, to the boiler room. In the Ben Venue power house at Pittsburg, Pa., a fly-wheel 20 feet in diameter, 32 inch face, weighing 32,000 pounds, burst, resulting in great damage. The generators being driven by the engine short-circuited. The belt slipped and the driven pulley breaking, parted the belt which, drawn toward the engine, stripped the governor of its connections. The engine being thus uncontrolled soon attained a dangerous speed, causing the fly-wheel to go to pieces. It will be readily seen in all these cases that if there were some means by which the steam could have been cut off immediately at the first indication of serious damage the whole danger would have been avoided. With the present safety devices this, however, would be hardly possible, as in one case the engineer knew nothing about the accident until it was over, and in the other cases there was either not time or it was too dangerous to go near the engine to attempt to shut off the steam. Under the present system of automatic engines the safety valve is generally kept wide open, so that in case of large engines it is at best a slow job to turn up the throttle wheel sufficiently to shut off steam; and it is in most cases this inability to instantaneously shut off steam that makes so many of these accidents possible. Then also it should be in the power of the engineer, fireman or any intelligent workman to stop the engine quickly from any point where there is danger of serious accident, whether this should occur in the engine room or in the factory a considerable distance away. In the large majority of cases the greatest damage occured between the time of noticing the first indications of danger and the time necessary to get word to the engineer and have him shut down the engine. It is this delay that is most dangerous.

A safety throttle valve and system of protection is being put on the market by the Standard Valve company, No. 175 Dearborn street, Chicago. The plan embraces an automatic device (having no connection with the governor of the engine) which will shut off steam instantaneously upon the engine attaining a dangerous speed and doing this by automatically making is impossible for the engine to "run away." This device is called the speed stop. The system also embraces a series of push buttons located at different points in the engine room and throughout the factory wherever there is shafting and pulleys and machinery located, as is shown in Fig. 5. These buttons are connected, so that by pushing a button from any point in the transmission system, the engine will stop immediately. The buttons in the shop or factory are covered with glass so they will not be tampered with by meddlesome people, it being necessary to break the glass before getting at the button. Those buttons located in the engine room are open, it being designed that the engineer shall make all regular stops by means of the buttons, thus keeping him daily advised whether his protection system is in perfect order or not.

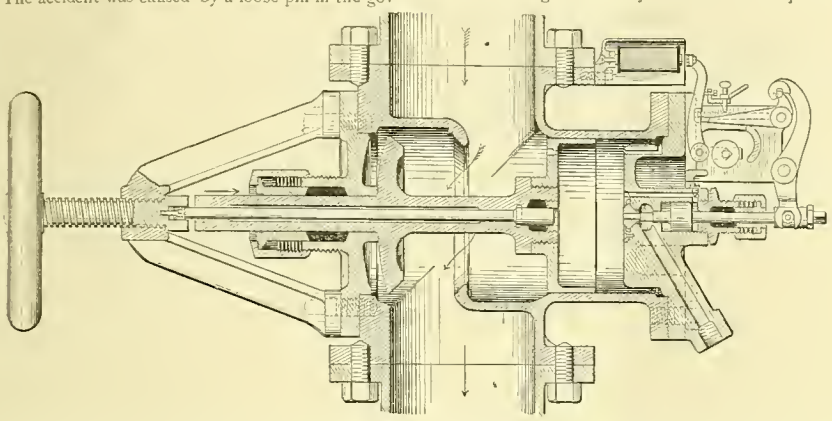


FIG. 4. ACCIDENTS IN LARGE POWER PLANTS.

The construction of the safety throttle is quite simple, and is made standard as to size and measurements between flanges, so that it is interchangeable with valves on existing plants, and in addition to the automatic feature fill all the requirements of the standard valves now in use.

Fig. 4 shows a section of the valve, in which it will be noticed that the valve stem is prolonged and has a piston on its extreme end. Behind this piston is a steam cushion, which keeps the valve open. In case it is desired to close the valve, all that is necessary is to release the steam cushion back of the piston. Thus the greater pressure being on the inside of piston, the valve is forced to its seat, and the throttle is closed. The steam back of piston is admitted through a small hole in piston and released by means of the levers on the end of the valve, which in turn are operated by push buttons and small magnets, as shown. The hand wheel is retained to open the valve gradually as is necessary with large engines.

The speed stop as shown in Figs. 1, 2 and 3 is a simple form of centrifugal governor which, when the engine runs over its proper speed to a point approaching danger, will make contact with the small attachment shown and the throttle will be automatically closed. This device is adjustable to operate at any speed desired and is very positive in its operation.

In the cuts, Fig. 1 shows a section of shaft with speed stop, Fig. 2 a top view showing the width of speed stop. Fig. 3 is a device connecting with safety throttle valve and attached to the engine so as to hold it firmly in position. Fig. 4 shows a section of the automatic safety throttle and Fig. 5 is a floor plan of a factory equipped with this system. The engine furnishing power to the Knisley building, 72 and 74 West Monroe street, Chicago, is equipped with one of these automatic safety throttle valves and can be seen at any time.

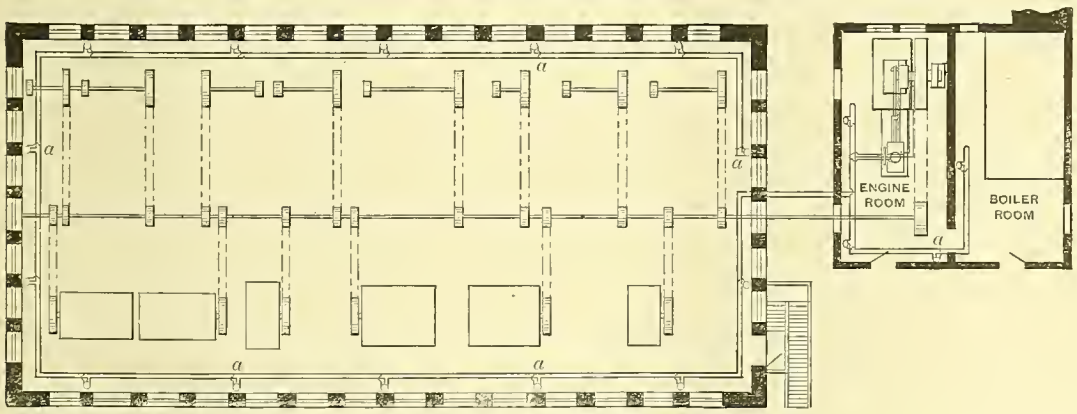



FIG. 5. ACCIDENTS IN LARGE POWER PLANTS.

## Steam vs. Electricity on the Railway.[1]

The wonderful growth of the electric railway as applied first to the ordinary needs of transportation in the streets of cities, and then to the traffic between city and suburbs, is now being paralleled by as rapid an extension into the heretofore undisputed realm of the steam locomotive. Ten years ago the electric street car was being exhibited as a curiosity in an exposition at Chicago. January 1, 1888, there were in operation in the United States and Canada 13 roads, 48.25 miles of track and 95 cars. Three and one-half years later, July 1, 1891, there were 354 roads, 2,893 miles of track and 4,513 cars. To-day the mileage of the electric railway in 24 cities in this country, all having a population of less than 500,000, is alone 2,000.

Until a short time ago the electric railway found sufficient room for development in the two departments of transportation mentioned, and improvement in apparatus and methods was sufficiently rapid to occupy the attention of engineers. Predictions were not wanting, however, as to the future of the "infant," and many of these are beginning to be realized. A turning point has been reached in the history of this system of transportation, and it is now entering upon a new phase of its existence.

The application of the electric motor to the propulsion of cars between cities is rapidly assuming proportions which are causing not a little apprehension in steam railway circles. Already the paralleling of steam by electric roads has in many instances materially affected the income of the former. A few roads have endeavored to meet this reduction by cutting off local trains many have reduced their fares to the 5 cent rate of the new bidder for public favor. In the more thickly populated portions of the country the competition between the two systems will first be felt more strongly. The New England states especially offer many inducements for the extension of street railway lines. Where a large number of populous cities are situated but a few miles apart, it becomes a simple matter to join the already existent lines into a system, which must necessarily offer to the short-distance traveler many advantages unattainable in steam railway practice.

Long-distance lines are being planned between a number of eastern cities, one of the most extensive being that with which it is proposed to connect Philadelphia with Harrisburg, over a distance of about 100 miles. Roads already exist between a number of the cities along the route. The main line will have feeders or branch roads touching many towns on either side, and the total mileage of the system will be 366, reaching a population of over 2,000,000. The Baltimore-Gettysburg line will be about 45 miles in length. Contracts for a portion of it have already been let, and the time is not far distant when it will be seen in actual operation. These two are but examples of the many roads being proposed.

The use of such systems as the above for other than passenger traffic is doubtless one line along which further development is to be made. Especially where the localities reached are market gardening regions, from which it is of the greatest importance to have a rapid means of conveyance to the city, will there be found profit in a freight service. The supplying of power for agricultural and municipal purposes might be made a paying "side line" for a road of this character. This idea was advanced by the promoters of the famous Chicago-St. Louis high speed air-line railway, as an essential feature of their plans. Whether this road will ever materialize and be able to test the efficacy of the scheme, we are unable to say. New applications for electric power are being found every day, and the twentieth century will surely see the day when electricity will have become all-powerful as has been steam during the nineteenth.

## Contract for City Lighting, Chicago.

There has been considerable comment over the awarding of the contract for street lighting in the Hyde Park district of Chicago. Comptroller Jones said on Monday he had not had time to look into the awarding of the contract. He said he had not familiarized himself with the affairs of his office sufficiently to be able to explain why it was that the Calumet Gas company was allowed to furnish electric lights at $137 a light when another company had bid $95. City Electrician Barrett is reported by the *Chicago Tribune* to have said: "The contract of the Calumet company expired last June and Controller Ackerman entered into an agreement with this company that it should furnish the lights at the same rate and wait for its money until such time as the city was able to pay. I knew nothing about this agreement until some time later, and when I heard of it I called the controller's attention to the fact that he hardly had the right to do this, and suggested to him that he advertise for bids. This he finally did, and I suggested that as there was no money to pay for the lighting, and, as the company that was lighting the streets was willing to wait for its money, the matter go over until the end of the year, when the council could make an appropriation and a contract with the lowest bidder."

Forest City, Pa., is said to offer a good field for a central station plant.

1. From the *Sibley Journal of Engineering* for November.

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THE London *Electrician* speaks of "a Chicago electrical contemporary" as having noticed "a most extraordinary and almost incredible" scheme for "pumping coal through pipes." We are quite sure that our English contemporary has reference to a New York journal—one that had its beginning in Chicago, to be sure, but which was compelled to remove from this city owing to lack of support. This error has appeared in the *Electrician* before, and as it leads to confusion that is exceedingly distasteful to those actually engaged in electrical journalism in Chicago, we are constrained to request our contemporary to avoid its repetition.

WITH the rapid development of electrical science, the literature of the subject has become so voluminous that the necessity for a carefully prepared index is becoming felt among those who are engaged in educational work or conducting experiments and investigations along special lines. This subject was discussed in a paper prepared by Prof. George D. Shepardson of the University of Minnesota and read before the American Institute of Electrical Engineers at its last meeting. The paper, which is printed elsewhere in this issue, gives an idea of what has already been accomplished in the line of compiling an index of general engineering topics. It must be admitted that the necessity for a special electrical engineering index has not been felt until quite recently, and such efforts as were made in this country to provide a classified list have not received much encouragement. It is really doubtful if the general reader has come to realize the importance of the subject, and it is not to be expected that a comprehensive system of this kind can be supported by specialists and a few college professors. However, it is well to direct attention to the necessity of taking up this matter, and Prof. Shepardson's paper will do much to bring the subject into prominence.

AMONG the official reports emanating from Washington at this time is one that will be read with special interest by street railway men. It is that of the second assistant postmaster-general, and one of the topics considered is the utilization of electric cars for transportation of mail matter. In this report occurs the following paragraph:

The electric car line is becoming each year a more important factor in mail transportation. Service is now in operation on forty-seven such lines at the rates fixed by law for the carriage of mails on steam roads. The routes thus far established are comparatively short, the longest being but eighteen miles in length. Consideration is now being given to the feasibility of utilizing electric and other rapid motor street car lines to facilitate the transportation of mails in the important cities between the main postoffice and branch offices, and to and from the railway stations. A plan of this kind would probably include the running of a special car over the several street lines for the exclusive use of the mail service, not only for carrying locked pouches, but in which a certain amount of distribution would be possible.

The practicability of this plan has been demonstrated, and unless some legal complications should arise, it is to be expected that the next year will see a rapid expansion of this plan.

SO MUCH interest has been shown in the discussion over the question of utilizing electricity in the execution of the death penalty that a correspondent of the *New York Herald* has sent by cable from London an interview with D'Arsonval who is opposed to the present practice. The doctor said that in examining cases where death had occurred through electricity he found nothing in lungs, heart or head to explain the cause of death, and inferred, therefore, that there was no real killing by the electric current, but a nervous shock sufficient to stop respiration. Six times he has restored animals apparently dead and four times he has restored men in the same condition. He illustrates his theory by the stroke of the toreador in a bull fight. He delivers what seems to be a mortal blow just back of the bull's neck. The sword touches the spinal column, the shock is communicated to the whole respiratory system and the animal falls apparently lifeless. D'Arsonval's method of treatment in such cases is very simple. He ties a handkerchief round the victim's tongue and pulls it out at regular intervals. The French scientist claims to have made this discovery in 1887. The remedy promises to be a valuable agency in saving life; but, if successful, it must necessarily put an end to the execution of criminals by the present method in New York.

A DAILY newspaper in New York city printed a series of interviews some time ago in which the question of spreading disease by the general use of public telephones was discussed. It seemed to be the general opinion of physicians that while it was possible that disease could be spread by this means under certain conditions, it was not at all probable that such was the case, and in fact there seemed to be little doubt that the point raised was rather far-fetched. Yet in spite of these views a couple of enterprising inventors have designed an antiseptic mouth-piece for telephones upon which they have secured a patent. The device can also be adapted to be used with speaking tubes, and here it may be remarked there appears to be greater danger than in the use of the telephone. However, in the device the month-piece consists of two shells, an inner shell and an outer shell, spaced a predetermined distance apart and forming a chamber into which the antiseptic material is placed. The shells contain a number of apertures and the air may pass through them, become impregnated with the antiseptic material and escape through other apertures. The most noteworthy feature of this innovation is the fact that the so-called invention of such a device illustrates the eagerness with which every opportunity is grasped by observers in this field who are ever ready to take advantage of public want or a popular craze.

DURING the last year, in fact during the whole of Mayor Gilroy's administration, the Board of Electrical Control of New York has conducted itself in such a quiet and business-like manner that it had almost dropped out of public view. The existence of this body is recalled by the fact that Mayor Gilroy has just named the new commissioners. Jacob Hess is the only member of the old board who has been reappointed, Amos J. Cummings being named to succeed Theodore Moss, and Henry S. Kearney taking Walton Storm's place. The board, as at present constituted, probably averages higher than any of the boards during the six years of the department's existence. Of course Hess is not expected to lend dignity or ability to the body, although he has been on the commission ever since the board was created. Ex-Congressman Cummings has heretofore given a good account of himself as a public officer, and his knowledge of affairs may be of service to him. Commissioner Kearney was identified with the board in its early days. It is a matter of fact, though, that there is really no excuse for the continuance of this body. The salaries of three commissioners aggregate $15,000 a year and it is believed the other expenses of the office will amount to $15,000 more. None of the members are fitted for this special line of expert work and their continuance in office is wholly unnecessary. The Board of Electrical Control as at present organized should be abolished.

CHARGES have been made against the Brooklyn surface road companies that they have been disregarding the city ordinances regulating the speed at which cars can be run within the city limits. It has been urged that many of the accidents on the trolley lines were due to the fact that the cars were operated at a dangerously high rate of speed, in fact so much in excess of the limit named in the ordinances that the grand jury has been asked to indict motormen and railway managers. In a recent interview Mayor Schieren said that if the cars were run at more than ten miles an hour he would take steps to punish the railroad officials. "I would like," he said, "to make a test case, so as to show these people that they do not own the streets. I have been trying ever since I took office to get evidence that any trolley car was run at a greater speed than ten miles, but I have been unsuccessful. When a citizen sees a trolley car speeding at a high rate, he should call a policeman and have the motorman arrested. The police have instructions to enforce the law." It would seem as if this was pretty good evidence that the trolley companies were keeping within the law. In a city where there has been so much opposition to the trolley as in Brooklyn it seems hardly possible that the companies could do anything that would give their opponents and critics an opportunity to call them to time without being obliged to defend their action. However, it is just as well for all concerned to watch the case. Friends of the trolley cannot afford to let the system fall into disrepute because of the criminal recklessness or carelessness of the officials or employes of any company.

IN the course of a series of articles on the manufacture of incandescent lamps, M. A. Bainville, in *L'Electricien*, presents a very interesting paper on the perfect incandescent lamp. He says it is evident to all that the present types of lamps are far from reaching the ideal, and his article is devoted largely to a consideration of methods proposed for attaining better results. There are inherent imperfections in the lamp due to the principle of construction, and there are others that depend upon the manner in which the principle is applied. In the first place, it is contended that the filament is a bad transformer of electrical energy into luminous energy, since existing lamps have barely an efficiency of 5 per cent., and even by increasing their working temperature he does not expect to obtain in luminous energy more than 10 per cent. of the electrical energy consumed. Progress must be looked for in increasing the efficiency of this transformation. Other defects are caused by the wear of the filament, due to the variation of the electrical resistance, and also to the variation of the nature of the surface of the filament, which influences the value of the lighting power. The transparency of the bulb and the modifications it undergoes during the life of the lamp are due to imperfections of manufacture. M. Bainville says that the perfect incandescent lamp can be defined as one in which the physical properties of the filament remain constant during the whole of its life. This duration should be as long as that of existing lamps. The filament should be enclosed in a bulb of perfect transparency and constant during the life of the lamp; the vacuum in the bulb should be as near as possible an absolute vacuum, and it should be maintained in such a condition all the time the lamp is in operation. A lamp of this kind should, moreover, automatically terminate its life as soon as one of the conditions named was lacking.

In order to meet these requirements the author suggests that investigations into the improvements to be introduced in incandescent lamps should be devoted to perfecting filaments formed of a single substance, and not of a mixture. This substance, it is pointed out, should possess the properties of infusibility at least equal to that of carbon, a higher specific resistance, large emissive power, and great elasticity. Furthermore, it is suggested that it might perhaps be possible to effect the transformation of electrical energy into luminous radiations in a more perfect way than by the method of incandescence. The luminous phenomena which accompany discharges in vacuum, and the illumination presented by rarefied air-tubes placed in the magnetic fields of high frequency, it is suggested, may be the point of departure of new and fruitful investigation. At present the discussion of this topic is particularly timely, and it may be expected that the suggestions advanced will receive thoughtful attention.

## Electric Railway Construction.

An interesting paper on "Electric Traction, with Special Reference to the Installation of Overhead Conductors," was presented to the Institute of Electrical Engineers, London, on November 8th, by Robert W. Blackwell and Philip Dawson. This paper is based upon data collected during the last six months while the authors were studying construction on the principal American lines, and in visiting the late large continental installations. Following is an abstract of the paper:

The marvelously rapid and successful introduction of electric traction in the United States is now an old story. That 600 electric tramways are there operating nearly 9,000 miles of track and 20,000 cars, that nearly three-fourths of the tramway movement of the country is electrical, that £45,000,000 is there invested in electric tramways, and that this tremendous result has been, to all intents and purposes, effected within five years, cannot but appeal pleasantly to the electrical engineer. Germany, France, Belgium, Austria, Switzerland, are already investing millions in electric traction, and there seems every reason to believe that England will shortly join the march of progress.

Probably no practical point in electric traction was less understood a few years ago than "rail bonding," and a few words may be added to what has been said on that subject. Its importance has but recently been appreciated, and it is of first importance. It may be taken that the bonds connecting rails should be, as nearly as possible, of the same current capacity as the metals themselves. If a 70 pound rail be used, the sectional area of copper bonds should be as nearly as possible seven-sixths square inches, the ordinary steel rail having approximately one-sixth as much conductivity as commercially pure copper. This would exceed nine No. 0 copper wires.

When electric roads were first constructed a No. 4 galvanized iron wire was considered sufficient.

The contact surface of bond and rail should be as large as possible. With heavy bonding and insulated return circuit feeders the danger of corroding gas and water pipes (a danger that has been greatly and unnecessarily exaggerated) is practically nil. The Toronto, Baltimore, Salt Lake City and many other systems may be cited in support of this statement. In cities earlier equipped, where the lightest of rail bonds and return feeders were employed and very heavy current dealt with, serious results undoubtedly ensued, as at Boston, where electric traction was first installed on a large scale. By the use of modern appliances the trouble there has almost ceased to exist. The tramway company employs special workmen to accompany gas and water construction gangs, and to connect all water and gas pipes laid in the neighborhood of the power house to heavy bare copper cables returning to the stations. It must, however, be borne in mind that in that city an approximate total of 13,000 electrical horse power has to be dealt with by the three power stations of the West End Street Rail way company. The following are the figures of January 27, 1894, on which day 577 cars and 71 snow plows were running:

| Stations. | Hours run. | Mean current for the day. | Maximum current. |
|---|---|---|---|
| Aleston | 16 | 1,203 amps. | 1,580 amps. |
| Cambridge | 18 | 4,088 " | 5,425 " |
| Central | 24 | 12,706 " | 14,400 " |

The average monthly car mileage of this line in 1893 was 1,325,000 miles.

Prof. Jackson of the University of Wisconsin has found by experiment that the chemical composition of the soil has a great influence on corrosion. The most favorable to it, and having the smallest resistance, is that in which there is the greatest proportion of chlorides. Nitrates come next and sulphates last. If, after all ordinary precautions are taken, corrosion still continues, bare copper cables are connected to the negative terminal of the generators at the switchboard and to all pipes in the neighborhood of the station. So far as possible the use of earth for the return circuit should be avoided. In conversation lately with Mr. Sprague, he laid great stress upon the advisability of laying the rails upon good stone ballast and coating all bonds and connections with insulating and preservative compound.

The practice of laying bare copper wires along the whole length of the track, once regarded as indispensable, is now practically abandoned. It has been found that wire so laid rapidly deteriorates and wastes away. All the copper is put into the bonds, the rails are cross-connected approximately every 90 feet, and where the volume of current exceeds the economical carrying capacity of the bonded rails insulated return-circuit conductors are employed.

Whether electric welding will eventually take the place of all bonding is still an undecided question. It has not yet stood the test of practical use on a large scale for a sufficiently long period to pronounce an opinion. When first introduced in Boston it was not successful, many rails breaking near the joint after some months' use. The process has since been improved, and a trial section of line was in course of being welded when the West End street railway was visited last June. Seven miles of welded track have given satisfaction for some months in St. Louis. Over 100 miles are now being welded in Brooklyn, and the result of this trial will demonstrate, after a year or two, the value of welding. At present it takes from 10 to 15 minutes to make a welded joint, and on an average a current of about 250 amperes at 550 volts is necessary, which is transformed into an alternating current at two to three volts pressure. Approximately, each joint costs 12s. to 15s. It is said that the pioneer company in electrically welding rails has already invested over £120,000 in experiments. It is worth mentioning that modern American practice is to butt the rails, allowing nothing for expansion, wherever the streets are paved. The result is a nearly perfect joint. With heavy cars, having at least four to five tons load on each axle, this is of the highest importance.

Mr. Wilkinson refers to the possible adoption of the three-wire system for electric tramways. That system has been in satisfactory use in Portland, Oregon, for the last four years. Compound-wound generators, working at 500 volts without load, and 550 volts with full load, are used. The success of this system depends upon the load of the various sections being nearly balanced. At Milwaukee, where local conditions did not allow of proper balancing, the system was tried and given up as a failure. The three-wire system was introduced at Portland because the generating station was three miles away from the nearest point of the line, and the cost of feeders would have been necessarily heavy. By the three-wire system 1,100 volts could be used, —550 and + 550, between each two sections of trolley wire. The rails were connected to the neutral terminal at the switchboard. The average load on this station is 1,500 horse power. It is located near a huge lumber mill, and the fuel is carried by automatic conveyors directly from the waste lumber yard into the furnace. Several tramways derive their power from this station at a cost of about 25s. per horse power month, 18 hours' daily work. Thomson wattmeters register the current used. The station pays about 40s. a day for its supply of fuel.

The enormous carrying power of an electric tramway at a pinch is an interesting feature. The following figures, given by Mr. Bowen of the Chicago City Railway company, show the work done by his electric line on Chicago Day at the World's Fair: 51 double-motor cars, 10 single-motor cars, and 73 trail cars were in operation over 26 miles of track. During the day 208,575 passengers were carried, and 11,271 car miles run. The maximum output at the power house was 17,000 amperes, and the average for 20 hours about 1,050. The minimum current registered was 750 amperes, and the average station pressure 540 volts. The ratio of expenses to receipts on this line is 40 per cent.

The largest electric tramway equipment in the world is that of the West End Street Railway company in Boston, U. S. A. Its adoption of electrical motive power practically establishes the economic value of that method of operation. The figures extracted from its annual reports are shown in Table A.

Attention is especially directed to the decrease in percentage of working costs to gross receipts, which has varied almost directly in proportion to the introduction of the electric plant. This reduction has been made notwithstanding the fact that the additional investment required for the introduction of the electric plant had to be provided for and that such part of the company's former plant as was rendered useless or disposed of at a loss had to be written off. A comparison between the tramways of London (population, 4,306,411 in 1893) and Boston (population, 417,720 in 1890) is interesting:

TABLE A.

| To November 30th of | 1888. | 1889. | 1890. | 1891. | 1892. | 1893. |
|---|---|---|---|---|---|---|
| Total miles of track | | 233.24 | 234 69 | 244.00 | 259 80 | 268 33 |
| Miles electrically equipped | | | 65 46 | 81.23 | 148 04 | 182.50(e) |
| Number of horse cars | 1,584 | 1,794 | 1,694 | 1,662 | 1,226 | 826 |
| Number of electric cars | | 47 | 337 | 469(a) | 1,028 | 1,346(f) |
| Total revenue miles run | 15,431,758 | 16,573,831 | 17,665,360 | 17,462,572(b) | 17,468,360 (c) | 18,769,809(d) |
| Electric revenue miles | | | | 4 528,186 | 9 622,000 | 14,780,054 |
| Percentage of expenses to earnings | 82 | 82 | 77 | 74.4 | 70 8 | 68 |
| Investment in electric (dols) | | 412,600 | 1,510,321 | | 5,752,694 | 7,6 8 069 |

(a) The long cars introduced at this time, and now almost exclusively used on the company's electric lines, are almost twice the size of the regular two-horse car.
(b) Electric mileage 26 27 per cent. Horse mileage 73 73 per cent.
(c) Electric mileage 48 63 per cent Horse mileage 51.37 per cent.
(d) Electric mileage 76 17 per cent. Horse mileage 21.83 per cent.
(e) And 25 additional miles partially electrically equipped.
(f) And 24 electric snow-plows.

| | London. | Boston. |
|---|---|---|
| Miles of street operated | 125⅝ | |
| Miles of single track | 250 approx. | 268½ |
| Number of cars | 1,080 (a) | 2,172 |
| Car miles run | 21,924,290 (b) | 18,669,809 |
| Total working expenses | £885,967 | £910,147 |
| Total receipts | £1,070,578 | £1,338,515 |
| Net receipts | £184,611 | £428,368 |
| Percentage of expenses to receipts | 82.7 (c) | 68 |
| Total capital invested | £3,533,177 | £4,435,000 |
| Rate of interest paid on ordinary shares | 3.32 per cent. | 9 per cent. |

(a) London uses top-seat cars, Boston does not. Boston has to keep a double set of cars open for summer, closed for winter. (b) London has the greater number of car miles run. The majority of Boston cars are much larger than the London ones. (c) No ton investment includes £1,500,000 spent during the last five years on re-equipping electrically.

If London's percentage of expenses to receipts could be reduced from the present 82.7 to 70 per cent., net receipts would be increased to £321,174; if to 60 per cent., net receipts would be £428,231. It is almost unnecessary to call attention to the fact that the cost of material and labor involved in the re-equipment electrically of a tramway is much higher in America that in England.

In the early days of electric traction no greater annoyances fell to the lot of the much tried tramway constructor than those which seemed inseparably connected with the suspension and effective insulation of the conducting wire. No material was obtainable possessing the happy combination of strength, durability and high insulation with inconspicuousness; interchangeability of parts was unknown, and unsightly, rough-and-ready expedients were used wherever difficulties in erection were encountered. From 1884 to 1889 no insulator better than paraffined wood or porcelain could be obtained. This is the best device the Bentley-Knight Electric Railway company could evolve to support a bar copper conductor in its conduit system laid in Boston in 1888. It is composed of a block of porcelain leaded into a malleable iron holder, and having a brass support for the conductor leaded into it. All of the earlier elevated conductor lines were dependent for their insulation upon the wooden poles by which they were supported, and in wet weather the resultant leakage was a very serious factor. With the introduction of iron poles, and the development of motors and power plant, something better and more permanent became a necessity. The wide extension of electric traction is largely due to the enterprise of independent manufacturers, who, seeing a great and growing need, undertook the elaboration of a system of electric tramway supplies to meet the demand, and relieved the electrical companies of constant consideration of the details necessary for safe and economical transmission of current from power house to car motor. The taut and workmanlike overhead line of to-day, in erecting which the lineman has had at hand a compact and appropriate device for every insulating or supporting point, differs widely from the unsightly webs which were the rule in earlier years.

Of that important factor, the trolley wire itself, little need be said. The universal American practice is to employ No. 0 hard-drawn copper. Many continental lines have employed lighter trolley wire—in some instances as small as 6mm.—and some use larger. It may be taken, however, that No. 0 is the size that gives the best all-round results. Phosphor bronze is of doubtful utility as a substitute for hard-drawn copper, the increased tensile strength being more than overbalanced by the reduction in conductivity. The manufacturer of the trolley wire should guarantee 98 per cent. conductivity or better, and perfect joints, and should deliver wound on special reels in mile lengths.

Several forms of construction are described in detail and a number of devices with which all American electric railway men are familiar were shown. The authors gave particular attention to the development and improvement that had marked American practice. It is noted, too, that in this country electric heating of street cars has become quite general. The paper concludes with the following comment:

A word may be said in support of what Mr. Wilkinson has said as regards the appearance of overhead conductors. Undoubtedly some aerial lines have been put up with an utter disregard of appearances, and inexperienced or careless constructors have erected webs of trolley, strain and feeder wires which were most obnoxious. This is expecially true of many hastily-built American lines, pushed through at high pressure, and at the smallest possible expenditure. Now that the first rush is over, and the tramway operator, the manufacturer and the contractor have had time to take breath, the weight of public and press criticism has had its effect, and no pains are spared to perfect the entire plant and apparatus. A carefully designed and erected line, with sub-surface feeders, handsome poles, etc., has but few objectionable features; and in the great majority of cases public convenience is so greatly enhanced by the overwhelming advantages that closely follow upon the introduction of improved and more rapid transit facilities, that opposition to the extension of a trolley line is almost unknown. The Siemens line at Guernsey, the line that crosses the great piazza on which Milan Cathedral stands, the Brussels, Hamburg, Bremen, and a dozen other continental installations, are European examples of line construction to which no reasonable objection can be urged. The electric tramway has a future as great in Great Britain as elsewhere, and in no other country in the world has it failed to already secure universal acceptance.

The English tramway operators and the able executive officers of the Tramways Institute of Great Britain and Ireland are keenly alive to the possibilities that lie in electric traction, and, under most adverse conditions, are doing their best to smooth the path of progress. It remains with you, gentlemen, to supplement their endeavors, and to do your best to stimulate and encourage the growth of public opinion in its favor.

## Litigation Over Cable Contract.

The action of the Denver Heat, Light & Power company against the Standard Underground Cable company for a sum approximating $60,000 has attracted considerable attention. The case was tried before Judge Acheson of the United States Circuit Court, and evidence was introduced showing that the cables had been carelessly laid during the progress of their installation. The evidence was largely of an expert character and very complicated and apparently little understood by the jury. Notwithstanding the favorable charge made by the judge in his instructions to the jury, a verdict was returned in favor of the plaintiff for $36,000. A motion for a new trial was made.

## National Electric Light Association.

Arrangements have been made for holding the eighteenth meeting of the National Electric Light association at the Army and Navy hall, Cleveland. The headquarters of the association will be the Hollenden hotel.

A Waukegan, Ill., dispatch says: Four men accompanied by a surveyor are in town prospecting for the proposed electric trolley line along the lake shore from Chicago to Milwaukee. The road is to run on the highways instead of having a separate right of way. It may come up Marion street, which is the principal road into town from the south.

## American Institute of Electrical Engineers.

At the meeting of the council of the American Institute of Electrical Engineers at 26 Cortlandt street, New York, November 21st, the following named associate members were elected:

Joseph Appleton, Philadelphia, Pa.; George F. Archer, Garden City, L. I.; Frank M. Ashley, New York; Charles Blizard, New York; C. G. Davenport, New York; W. S. Hadaway, Jr., New York; Wm. L. Hedenberg, New York; Chas. K. Munns, Chicago, Ill.; A. E. Brooke Ridley, San Francisco, Cal.; Francis G. Robinson, Brooklyn, N. Y.; William Wesley Varney, Baltimore, Md.

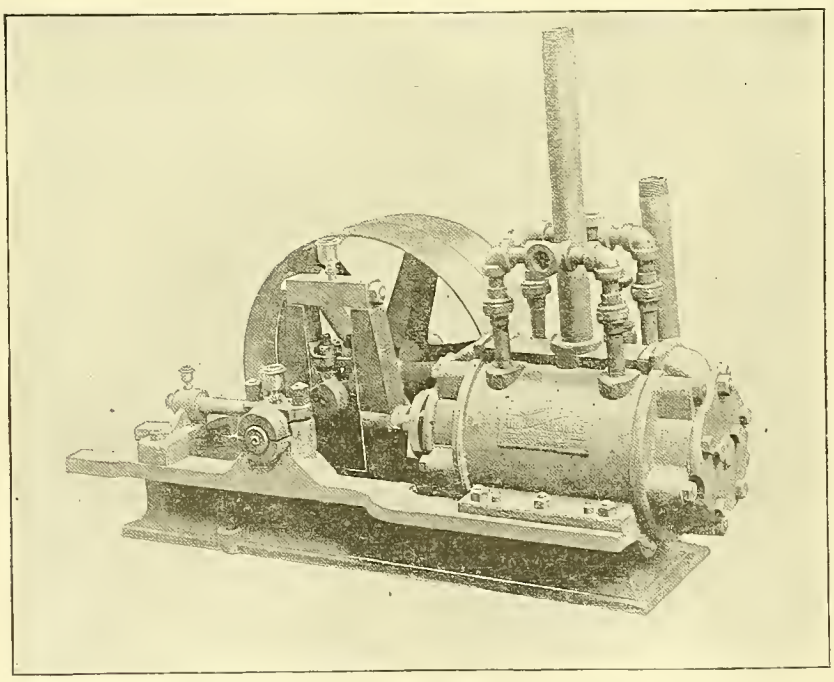
The following named associate members were transferred to full membership:

H. S. Sands, Wheeling, W. Va.; Norman N. Ross, Winnipeg, Man.; W. C. Cheney, Portland, Ore.; Fred A. Bowman, New Glasgow, N. S.; F. W. Tischendoerfer, Nuremberg, Germany.

At the Institute meeting held the same evening a paper was presented by Professor George D. Shepardson of the University of Minnesota, entitled "Suggestions for an Index of Engineering Literature." In the absence of the author, T. C. Martin read the paper and opened the discussion, which was participated in by Messrs. Crocker, Caldwell, the president and the secretary. Written discussions were also communicated by Carl Hering, J. Stanford Brown, M. Osterberg and Prof. Goldsborough. Prof. H. J. Ryan also sent in a communication upon the subject of "Reactance," in discussion of the paper read at the Philadelphia meeting.

## Clayton Vacuum Pump for Exhausting Incandescent Lamps.

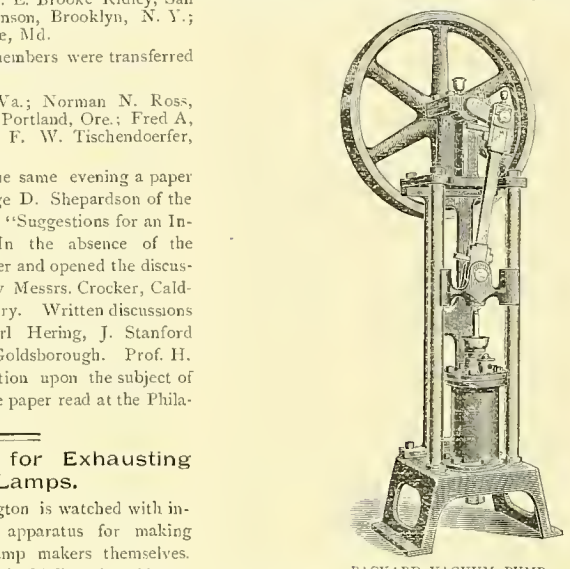
The patent litigation at Washington is watched with interest by the manufacturers of apparatus for making incandescent lamps as well as lamp makers themselves. Many improvements have been made in this line of machinery, and in none has greater advance been made than in pumps. The accompanying illustration shows the Clayton vacuum pump, in its improved form, built especially for exhausting incandescent lamps. This pump, which is designed to be operated by belt power, is of the double acting type, with valves at each end of the cylinder, thus drawing in its full cylinder capacity twice at each revolution. The valves, which are of the poppet type, both suction and discharge, are of a composition metal especially adapted to the service, and the seats are protected by vulcanized composition disks, obviating excessive wear and prolonging the life of the valves. The cylinder is lined with hard composition metal and is surrounded with a water jacket for surface cooling. The piston rings are of composition metal and are adjusted by a patented device which insures absolute and permanent tightness under a high vacuum, with minimum frictional wear. The steel yokes are fitted with the Clayton patent sliding journal boxes, so arranged as to be capable of perfectly tight adjustment at all times. The pump is equipped with tight and loose pulleys and is as strong and compact as it is possible to make it. The manufacturers construct this pump in six sizes, ranging from five inches diameter by five inches stroke to ten inches diameter by nine inches stroke. A design is also furnished to operate by direct steam pressure. The pumps are tested under thirty inches of vacuum and are made and sold by the Clayton Air Compressor Works, Havemeyer building, 26 Cortlandt street, New York.



CLAYTON VACUUM PUMP FOR EXHAUSTING INCANDESCENT LAMPS.

## Packard Vacuum Pump.

The accompanying cut illustrates a new model of the Packard vacuum pump. These pumps are universally used in incandescent lamp factories for the production of the preliminary vacuum in the lamps before the mercurial pump is set to work, for the operation of the mercurial pump and for producing a vacuum in the flashing bottles where the lamp filaments are subjected to the operation of flashing or "treating." These pumps have not heretofore been made with a single cylinder, as they were designed primarily for use in factories where a number of them were required and were therefore for the sake of compactness and economy of operation made with two or three cylinders combined in each pump. To meet the demand for the high grade vacuum pump for use in laboratories and experimental work in lamp factories the single cylinder design is now put on the market. For simplicity and compactness this is built with a single cylinder of large diameter and ample length. The frame, as will be seen, is open, making all parts perfectly accessible and is perfectly rigid. The valve arrangement, which has lately been improved and strengthened, is precisely the same as in the larger sizes of Packard pumps, and the pump is in every way adapted to heavy continuous work. A vacuum within one-half inch of the barometric pressure is readily obtained. The pump illustrated has a cylinder 4½ inches in diameter by 8 inches stroke. The Packard vacuum pumps are manufactured under the patents of J. W. Packard by Norman Hubbard of 93 Pearl street, Brooklyn, N.Y. They are universally employed by lamp makers, there being at the present time over two hundred of them in use.



PACKARD VACUUM PUMP.

## Manufacturers' Conference.

The Manufacturers' association of Cincinnati and Hamilton county, Ohio, has issued a formal invitation to similar organizations to be represented at a conference of manufacturers, which will be held in the city of Cincinnati on the 22d day of January, 1895, for the purpose of general interchange of views looking to the formation of a national association of manufacturers, which shall embrace among its purposes: First, the advocacy of carefully considered legislation to encourage manufacturing industries of all classes throughout the country. Second, the discussion of ways and means whereby trade relations between the United States and foreign countries may be developed and extended. Third, the establishment in South American capitals and other desirable points of permanent expositions for the display of American products. Fourth, such other topics as may be agreed upon by the convention.

It is desired that this convention shall be non-political, non-partisan and non-sectional.

Invitations are extended not only to accredited delegates from organized exchanges, representing manufacturing interests, but to any individual manufacturer who may have the promotion of the general good by organized effort sufficiently at heart to be willing to attend the meeting.

## Electric Light Transforms a Virago.

In its description of the recently enlarged electric lighting plant of Atlantic, Iowa, the *Telegraph* of that place notes a curious beneficence that has resulted from the improved illumination. It says:

The new engine, a Hamilton-Corliss of 200 horse power, is to the mechanical mind a thing of beauty, and to John Groves, the engineer, a joy forever. As the ponderous fly-wheel, of weight 20,000 pounds, turns silently upon its bearings and the sparks from the four dynamos bespeak that wondrous force which no one can describe, the current speeds swiftly out upon the wires to every quarter of the town. In the business house it casts a flood of light over the bookkeeper's desk, as he adds; in the homes it make cheerful the cosy sitting room, and in the heart of the domestic who used to fill the lamps it sheds a light that has changed her nature and turned a virago into the courteous hired girl that she should be.

## Important Wire Contract.

Through their western agent, Francis E. Donohoe, the American Electrical Works of Providence, R. I., has sold to C. T. Yerkes, for the North and West Chicago Street Railroad companies, $118,000 worth of feeder cable and trolley wire for the extensive electric railway systems now building for these companies. The wire called for by this contract will comprise more than 900,000 pounds of copper.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, November 24.—At the meeting of the Rapid Transit Commission on Tuesday of this week a letter from Commissioner John H. Starin, who has gone to Europe, was read. The following extracts are of particular interest:

I favor in general the lines adopted by the last commission, namely, a four-track up Broadway and on the West Side to the city limits, with a four-track line on the East Side extending beyond the Harlem river. The Elm street route would seem to meet the demands for a continuation of the East Side line below Fourteenth street, if, for new and far better reasons than have yet been advanced, it is decided that Broadway cannot be used for a four-track road below Fourteenth street, although I'm strongly in favor of this route for the Rapid Transit road, even though it cost more money. Then my choice would be the Elm street route for the East Side line and a line through streets parallel to and close to Broadway for the West Side.

I believe, however, that Broadway can and ought to be taken for the main or West Side line. I do not consider the question of vaults and sewers as very serious. The street, from houseline to houseline, belongs to the people, and should be turned to the best use. If vaults are to be taken for the underground road some Broadway property owners will necessarily suffer inconvenience. But the rights of the few must yield to the general good. The possibilities of an underground road in the city have, in my opinion, been never fully realized by the public. The underground road which New York ought to, and ultimately will, have must be planned on a magnificent scale.

It should not be a mere passenger road. It ought to be a great railroad—a railroad calculated to carry all the vast internal commerce of the city. It should be planned to do a part of the work now done by barges, tows, trucks, express and delivery wagons. It should be more than a mere sub-surface artery traversing the city north and south. It must become in time a vast railroad system competent to do most of the traffic in passengers and freight now carried on upon the surface, and of such size and nature that in future a passenger may enter his car in Chicago or St. Louis or other distant point and not be required to change cars until he reaches

the station in the underground road in New York that is nearest to his destination. It should be planned that freight could be billed, locked and sealed at the underground receiving station and carried to any point reached by the railroads in the country without breaking bulk.

The construction ought to be made of not less than four tracks, contained in one well-ventilated, thoroughly lighted tunnel, to avoid the noise and other discomforts of a narrow separate tunnel for each sets of tracks. All the tracks should be devoted during the day to passenger traffic, while at night one-half the number would serve, and the other half could be used for freight entirely.

Hundreds of thousands of dollars are annually expended in New York for transporting mails within the city limits with the primitive, unsafe and slow method of wagon delivery; an immense sum of money is also annually expended by the express companies in transferring their express matter from one portion of the city to the other by wagons; a proper underground system would provide for the transfer of the mails and express matter far more economically, expeditiously and advantageously. * * * *

Beyond doubt electricity has reached such a stage of development that the proposed system of underground railways can be operated by electricity at a greater speed and more cheaply than by steam. The same power could ventilate and light the tunnels and provide safeguards against accidents on the lines, so that every imaginable objection will upon actual operation immediately disappear.

The fulfillment of this idea, far from being impossible, does not to me seem even very difficult. The plan I would propose must comprehend such an idea in its inception. A double-deck road is apparently out of the question.

I recognize the difficulty of the undertaking. I also appreciate the seriousness of the trust placed in the hands of this commission. I feel that there is an implied limit of expenditure, beyond which the public demands that we should not pass. The powers placed in the hands of this commission are so great that the simple consideration of them is a serious matter. The voters of the city have by a large majority confirmed the trust imposed on us. As I understand the situation, we have been distinctly directed to undertake and carry forward to completion with the least possible delay a plan of underground railways that shall be worthy of our great city. No temporary makeshift will answer.

Two men, Augustus Kraushaar and Jacob Bessinger, were recentlyarrested at 54 West Twenty-eighth street on the belief that they were wire tappers. Bessinger rented a small back room in the house, telling the landlady that he wanted it for an office. The woman did not notice anything wrong about the man except that he sometimes had as many as fifteen or twenty callers in a day. She finally grew suspicious and told Capt. Schmittberger that she thought things were not exactly as they ought to be. When the detectives arrested the men they found a wire running in the back window, a set of instruments, and Bessinger operating the key. The wire that led into the room runs directly over the house, and belongs to the Western Union company. The police found in the room racing cards of the meetings at St. Asaph and at Nashville. The friends of the prisoners say that they were not tapping wires at all. They say that they were employed by a pool room keeper in the neighborhood, who, fearing detection if the wires were run into his place of business, had the results of the races received in the room in Mrs. Taries' house and then forwarded by messenger. Kraushaar said that he was a salaried Western Union operator.

Attorney-general Hancock has written an opinion on the proposed scheme to attempt to resuscitate an electrically executed criminal. He says: "In my judgment neither the governor of the state, the superintendent of state prisons nor the warden of Auburn prison has authority to deliver the body of a convict after the execution of the death penalty and a post-mortem examination to Dr. Gibbons or any other individual not a relative of the person executed. If the body is not claimed by a relative, it is the duty of the authorities in charge to bury it and not to deliver the body to an individual for any purpose or experiment." W. F. O.

## Northwestern Notations.

MINNEAPOLIS, November 24.—Wire Inspector W. E. J. Deming of this city reports having inspected during the last ten months 39 generators, 103 motors, 493 arc lights, 12,434 incandescent lights, 578 incandescent wiring and lighting contracts, 291 aerial wires, 27 electrical heaters and 56 converters. Of these 3 generators, 4 motors, 7 arc lights, 25 incandescent lights, 84 contracts of wiring and lighting, 164 aerial wires, 19 electrical heaters and 4 converters were condemned. Mr. Deming is anxious to have the underwriters secure data on all fires which are charged to defective wiring, etc., with photographs of the imperfect electrical apparatus. He has tried this plan in Minneapolis and has been able by systematic investigation to reduce these fires to a minimum.

The Fort Dodge, Ia., Telephone company proposes to extend lines to Cherokee on the west, Humboldt on the north, Waterloo on the east and Des Moines on the south early next season.

S. T. Meservey has secured control of the Fort Dodge, Ia., electric light and power and gas companies. The plant will be remodelled and improved.

Telephonic connection has been completed between Little Falls, Minn., and Pierz, 15 miles distant.

The Ottumwa Street Railway company will build a half mile extension on the south side line in Ottumwa, Ia.

The Fort Wayne Electric corporation has the contract for an electric light plant in St. James, Minn., at $5,842, the plant to be completed December 15th.

The franchise of D. M. Benton & Co. for electric lights in Galesville, Wis., has been extended 15 years.

J. K. Tillotson says the delay in granting a franchise for the proposed interurban electric railway at Kaukauna, Wis., will not delay work at Oshkosh, but that as soon as Neenah gives the desired franchise, work will be begun. If Neenah and Menasha refuse the franchise, the deal will be off, but he expects to get the matter fixed at those places soon.

Chas. J. Stackpole of Harrisburg, Pa., and others have applied for a franchise for an electric road in Hot Springs, S. D., to give the Hot Springs and Wind Cave road an entrance to the city. They claim that work will begin on the line, which is to be 12 miles long, as soon as plats for the right of way can be filed with the secretary of the interior.

The Minneapolis General Electric company has ordered three feed water heaters of 1,000 horse power each.

The new park electric railway of Lyons, Ia., has been formally opened. This is the second electric line for Lyons.

N. L. P.

## Milwaukee, Wis.

MILWAUKEE, November 24.—The special committee of the Common Council appointed to inquire into the feasibility of establishing a municipal lighting plant held a meeting last Wednesday, but did not decide upon any definite recommendation, as two members of the committee were absent and it was desired to have City Engineer Benzenberg take part in the final discussion. The aldermen who were present, spoke in favor of the project, and the two aldermen who were absent are known to be supporters of the resolution. There was some talk of introducing in the Legislature a bill to give the city the power to operate not only an electric light plant of its own, but all other enterprises of a public character, including street railways. One of the influential members of the common council says that if the committee does not introduce a resolution providing for such a bill he will do so himself. The city attorney, however, is of the opinion that a special act of the Legislature is not necessary so far as the operation of an electric light plant by the city is concerned. Ald. Ramsey, who has done most of the figuring on the cost of an electric light plant such as the city would require, estimates that the plant, with the necessary equipment, underground conduit system, etc., capable of furnishing 1,000 lights, would involve an outlay of $600,000. The Chicago plant, he states, cost that city $688,000, so that he is of the opinion that his estimate is conservative. He does not think that the operating expenses would be more than $40,000 a year, which would be $40 per lamp per year. It would be necessary to issue bonds for the purpose, however, and it would also be necessary to raise 5 per cent. of the amount of the bonds every year as a sinking fund. This sinking fund would amount to $30,000. If the net rate of interest on the bonds were 3 per cent., the sum of $18,000 per year would have to be raised on this account, making the annual cost of the system $88,000, or, allowing for incidental expenses, $90 per lamp per year. The present price is $110. Alderman Ramsey, it will be seen, does not take into consideration the wear and tear of the machinery or the interest on the money invested. If the city carried out this plan the entire system would be underground, the alderman says, and at the end of twenty years the city would have paid for the system, and the cost per lamp would not then be more than $40 per year. He has still more favorable figures on the project if his plan of having city bonds run forty years is adopted. The sentiment in the council in favor of the municipal lighting scheme seems to be quite strong.

The city authorities have not yet decided the matter of lighting the city hall. Charles G. Armstrong, Chicago, reports that a capacity of 5,492 lights is needed at the city hall. Two 100 horse power dynamos and two 150 horse power dynamos would be required, and they would cost not to exceed $11,000. The cost of the engines and condensers would not be more than $10,000. This arrangement would give two reserve dyamos. The cost of wiring the city hall would be from $18,000 to $20,000, and the electric light fixtures would cost something more than $10,000. Mr. Armstrong said that it was a question in his mind whether it would not be better to have the plant made large enough to light the entire city, in which event it would of course be advisable to put the entire plant outside of the city hall. A plant of this character, Mr. Armstrong said, would not cost more than the city's lighting costs yearly now, unless he was misinformed as to the cost of the latter, and the saving would be considerable.

The Board of Fire Underwriters has appointed George S. McLaren electrician in place of A. L. Bennett, who resigned to go to Chicago. The duties are to inspect the electrical construction and apparatus of all the buildings in the city. Mr. McLaren is a graduate of the Institute of Technology at Boston. He has had practical experience in Boston and Chicago and for awhile was connected with the Edison company.

The Vliet street cars now leave West Water street at Oneida street bridge, thence run to East Water street, to Wisconsin street and to the Northwestern railroad depot. They follow the same route in returning and allow passengers to transfer between the East and West Sides.

The Oneida street bridge is to be supplied with an electrical apparatus for turning it. The street car company will supply the power. There is some talk of equipping Broadway bridge in the same way, but it would be necessary to extend the cable, as the street cars do not run over that structure, and the change is not likely to be made for the present.

General Manager Wyman of the Milwaukee Street Railway company has received samples of transfer slips used in St. Paul, Minneapolis, New Haven and other large towns and which will probably be introduced here. The transfer tickets were invented and patented by J. H. Stedman of Rochester, N. Y. On the face of each ticket are printed four male heads and two female heads. One of the male heads represents a beardless man, another a man with a mustache only, another with a beard and the fourth a man with a full beard. One of the female heads is surmounted by a hat and the other by a bonnet. A cross to be punched under each signifies young or old. The tickets are said to prevent "beating the road."

In the United States District Court Judge Seaman has entered an order making perpetual the injunction restraining the Two Rivers Manufacturing company from infringing patents of the Thomson Electric Welding company and directing the payment of all profits which have accrued to the defendant by reason of the infringement in the past. The attorneys for the contending parties amicably adjusted the amount to be paid on the latter score at $1. All the patents were for apparatus and processes for electric welding. They were Nos. 347,140 and 347,141, granted August 10, 1886, and No. 385,022, granted June 6, 1888.

The first considerable snowstorm of the season did not bother the street railway men very much. At 9 o'clock in the evening, after the storm had set in, eight electric sweepers were started out over the lines, and with the exception of one which broke down before midnight they were kept at work until 3 o'clock in the morning. At 5 o'clock in the morning thirteen salt cars were run over the lines and the street cars were run on time from the start. Arrangements have been made to repeat the work whenever it is necessary and the management asserts that cars will be run on time no matter how much snow falls. Last winter snow interfered considerably with street car traffic.

Sherwood Morton, a young man who is said to be a relative of Governor Morton of New York, arrived in this city a few days ago after having inspected the lines of the Long distance Telephone company from Boston to Chicago. Accompanied by a party of surveyors, he inspected every one of the 56,248 poles which support the wires of the long-distance line between Boston and Chicago. During the week he finished the inspection of the line between Chicago and Milwaukee. He makes a map of the line, showing the exact location of every pole, the name of the owner of the property upon which or in front of which the pole is located, the number of the wire which it carries and a large amount of information which is valuable to the company in locating and repairing breaks upon its line. Mr. Morton left Pittsburg August 25th and usually made about nine miles a day. During the last four years, in the performance of his duty, he has walked 4,017 miles.

Surveyors for the North Shore electric railway, by which it is proposed to connect Chicago and Milwaukee, have been at work south of the city, particularly at South Milwaukee, during the last two weeks. For part of the distance, it is said, the road will be built on public highways. It is supposed that the increase in the value of real estate along the line which will result from its construction will be sufficient to overcome the objections of the farmers to the building of the line on highways. A great deal of interest in the project is being taken in Milwaukee. The men who are connected with the steam railroads do not seem to be apprehensive that the electric line will hurt established interests to any material extent. Some doubt in regard to the completion of the road is expressed by them, and several assert that with two such competitors as the St. Paul and Northwestern railroads it would not pay expenses. Through traffic on such a line would be out of the question, they further declare, and it would have to depend upon local traffic. Vice-president Henry C. Payne of the Milwaukee Street Railway company said that such a line would pay well if extended as far north as Waukegan, but he had his doubts about the success of a through line. If the

project were carried out, he said, his company would do all in its power to help the new road to gain an entrance into this city and would co-operate with it on lease of tracks if necessary.

A company has been formed at Appleton by local capitalists to establish an electric light and power company which will bid for a share of the business now controlled by the Edison company. Contracts have been let for power house, poles, wires, etc., and the company expects to be ready to do business by January 1st. The plant will be constructed on the basis of 1,000 lights and will cost about $40,000.

Fort Howard now has electric cars. There is a decided conflict of opinion as to the advisability of granting a franchise for the construction of an electric railway to connect Fort Howard and Green Bay. Some of the business men of Fort Howard are of the opinion that the proposed line would benefit Green Bay only.

W. G. DeCelle of the Fond du Lac Light, Power & Railway company is experimenting with an improved arc lamp that can be attached to the incandescent circuit. Some new machinery has recently been added to the Fond du Lac plant. There are now at the power station five dynamos for arc lighting with a total capacity of 220 lamps, and three large alternators for the incandescent circuits, with a total capacity of 3,750 lamps.

The Milwaukee Street Railway company has been considering the discontinuing the running of Whitefish Bay dummy trains so far into the city as they run at present. The terminal now is at North and Farwell avenues. It is proposed to remove the terminal to Folsom place and Glen avenue. At the latter point the Lake Park electric cars leave the dummy track and go east to the park. The distance between the present terminal and the proposed terminal is about a mile. The franchise for the running of the dummy trains so far into the city expired several years ago, and people in the neighborhood are protesting against the use of the streets by locomotives. It is quite probable that the proposed change will be made in the spring.

The chief feature of the case which has resulted in the arrest of the two architects who planned the new almshouse and of two of the principal contractors is a question in regard to the putting in of the Johnson electric service. After the contracts had been let and the work begun it was found necessary to provide for the Johnson service as an "extra." It is now averred that in the specifications adopted by the county board provision was made for the Johnson service and that the specifications were afterward tampered with. During the preliminary hearing of the case, which has not yet been concluded, some of the contractors who submitted bids in the aggregate at the time that the contract was awarded have sworn that not only was the Johnson electric service provided for in the original specifications, under the head of steam heating, but that they, the bidders, included figures for such service in all their bids. The equipment of the new almshouse with this service will cost about $4,000, and it is claimed that the defendants have conspired to defraud the county of this and other amounts.

Mr. Tillotson has not taken any definite step yet toward the construction of his proposed interurban electric road in the Fox river valley. He has got a franchise at Appleton, but some of the other cities are still holding out. At Kaukauna there are charges of attempted boodling on the part of the aldermen, or some of them, in connection with the interurban franchise. Recently J. M. Thompson of Chicago, who is said to have a half interest in the project, and to be the pioneer cable line builder on the Pacific coast, having built most of the cable car systems of San Francisco, Portland, Seattle and Tacoma arrived upon the scene. He is impatient at the delay in getting the franchises. He declares that the capital stock of the company has all been subscribed, and that the money has been lying in a New York bank for four months. He submits documentary evidence in support of these statements, and he is supported in them by the agent which Oshkosh sent to New York to investigate the matter. Mr. Thompson asserts that the investors do not want their money to lie idle any longer. The company, he states, has already made conditional contracts for the building of the road, and would have begun work September 1st if the franchises had been granted. Until it knows whether it can get through Neenah and Menasha and Meno into Kaukauna it does not know whether it needs one power house or two.

On the other hand it is announced that the Appleton Edison Electric company believes that the Tillotson scheme is virtually dead, and that it is preparing to build an electric road from Kaukauna to Neenah. The officers of the Appleton company state that they had a plan for building an interurban road which was to have started in May, 1893, but it was abandoned on account of the hard times. The Appleton company is said to have sufficient capital at its disposal. It will use the old road at Appleton, and A. L. Smith, the principal promoter of the line, anticipates no trouble in getting franchises at Neenah, Menasha and Kaukauna. The company has an option on sufficient water power to operate the road. C.

## PERSONAL.

Charles E. Brown of the Central Electric company, Chicago, has been suffering from an attack of malarial fever.

Addison G. Waterhouse, the inventor of the Waterhouse arc lamp and arc system, who has recently returned from Europe, is now connected with the Mather Electric company at the works at Manchester, Conn.

M. Pfatischer of the Electro-dynamic company of Philadelphia is spending a few days in Chicago. Mr. Pfatischer has recently returned from an extended European trip, and he reports the storage battery industry on the other side as being in a healthy condition.

## NEW INCORPORATIONS.

Union Electric company, Halstead, Pa.; capital stock, $10,000.

Citizens' Telephone company, Akron, O.; capital stock, $100,000.

American Gas Engine Electric company, Chicago; capital stock, $250,000; F. M. Charlton, Chicago.

Clarksburg & Suburban Street Railway company, Clarksburg, W. Va.; to build an electric railroad; R. S. Gardner, Clarksburg, W. Va.

Sterling & Rock Falls Telephone company, Sterling, Ill.; capital stock, $50,000; to furnish telephone communication in Sterling and vicinity; Frank C. Wood, Sterling, Ill.

Carthage, Webb City, Joplin & Galena Electric company, St. Louis, Mo.; to construct an electric railroad; capital stock, $175,000; John N. Bofinger, St. Louis, Mo.

## ELECTRIC LIGHTING.

Elberton, Ga., has voted to issue bonds to provide means to erect an electric light plant.

Terre Haute, Ind., has secured a contract for all-night arc lights for five years at the rate of $63.95 per light per year.

The village council of New Duluth, Minn., has granted a franchise to Hurd & Son of the Hurd Refrigerator company for the purpose of putting in an arc electric lighting plant. In a short time an incandescent plant will be added

Appleton, Wis., famed in history as the location of the first incandescent central station plant in the United States, has a new company that is putting in an alternating current system. The old plant was, of course, an Edison installation.

One of the boilers at the electric light station at Elwood, Ind., recently exploded, demolishing the building and also wrecking the street car barns, a few feet away. One employe was caught in the debris and so mangled that he cannot survive, and a motorman received serious injuries.

The board of directors of the Bethlehem, Pa., Electric Light company has voted that at the annual meeting of its stockholders to be held at the office of the company on Tuesday, the 15th day of January, 1895, an election of the stockholders shall be taken for or against the proposed increase of the capital stock of the company from $100,000 to $150,000.

The *Pittsburg Dispatch* of November 22d says: "R. D. McGonnigle went to Philadelphia last evening to attend a meeting of the executive committee of the Pennsylvania Electric Light association. It is a new organization, and not many of the companies are members. Mr. McGonnigle said the object was to get in all electric light people. The aim of the association is mutual benefit. They will keep an eye on Harrisburg this winter to prevent being sandbagged by people who may want legislation adverse to electric light interests."

The proprietors of the Holyoke, Mass., Water Power company, who also control the gas and electric supply of the city, have authorized their treasurer to announce a reduction in rates on the following basis: Gross price per 1,000 cubic feet for gas, $1.50; prompt payment, 10 per cent. off; net, $1.35. Electric arc lights, 10 commercial users, $90 per arc per year, 6 nights per week; $67.50 per year, 4 nights per week; $63 per year, 3 nights per week—virtually a reduction of 10 per cent. This is the fifth reduction in rates made by the company in seven years, and all were made at the company's volition.

Clear Lake, Iowa, is electrically lighted. "This enterprising city," to quote the *Mirror* of that place, is now "the best lighted town in Northern Iowa." The *Mirror*, in describing the plant, mentions the "fine 80 horse power boiler," while the engine is "a handsome piece of machinery, with all the latest improvements." Of the alternator it says: "This is the handsomest, latest improved machine on the market, and gives a light that we have seldom seen equaled and never surpassed in brilliancy and steadiness." The *Mirror* also states that "the streets are lighted by 32 candle power incandescent lights, suspended in the center of the streets on each block of the city at street intersections, and while the light lacks the brilliancy of the arc, yet their illuminating power is surprising, and the service is first-class in every respect."

## ELECTRIC RAILWAYS.

The St. Charles Street Railroad company of New Orleans, La., is about to equip its lines for electric power.

Germany has adopted electric traction in recent years on a large scale, and to satisfy the demands of municipal authorities the Allgemeine Elektricitäts Gesellschaft, Berlin, has decided to publish its experiences in electric street railway construction.

A new street railway company in Detroit wants to secure a franchise for an electric road on about thirty miles of streets and offers to sell eight tickets for 25 cents.

It is said that the electric cars will soon run from Rochester, N. Y., to Pittsford and that plans are all perfected for the extension of the track to that town. The project has been agitated for some time.

The new electric railway line in Freeport, Ill., is completed, but the envious *Standard* of Sterling says that "it is said that the people are so afraid of the cars that the company will hardly do a paying business for several months."

At a recent meeting of property owners on Indiana avenue, Chicago, officers of the Chicago City Railway company endeavored to arouse a sentiment in favor of a handsomely constructed overhead trolley line on that street, but with little success.

T. S. Hodson is president, and O. P. Byrd secretary, of a company formed to build an electric line two and a half miles long, from Crisfield, Md., to Sterling's Point, to carry oysters. It is stated that New York capitalists offer to build and equip the road.

The *Toledo Bee* gravely makes the announcement that the Michigan Central Railroad company "proposes using electricity as a motive power," "converting the entire system from Buffalo to Toledo, via Detroit, into an electric line." The current, so the story goes, is to be obtained from the Niagara Falls plant.

At the annual meeting of the Citizens' Traction company of Pittsburg it was reported that the total receipts for the year ended October 31, 1894, were $639,388.39. Expenses were $456,800.83, leaving a profit of $182,587.56. The net earnings amounted to 6.086 per cent. The net earnings for the preceding year were 7.327 per cent.

A Grand Rapids, Mich., motorman distinguished himself the other day. He was howling down South Division street and saw a runaway horse coming down the track. He reversed the motor and ran backward at a lively gait until the horse overtook him, and then, grasping the bridle in one hand, with the other he turned the current off and applied the brake, stopping his car and also the horse.

The committee consisting of H. O. Nourse, M. J. Sullivan, T. C. Martin, W. Forman Collins, James W. Nagle, James Boyd and John B. Bennett, which was appointed to frame an expression of gratitude to those southern gentlemen who arranged the social features of the recent Atlanta convention of the American Street Railway association, has issued a tastefully printed testimonial of appreciation.

The Metropolitan Street Railway company of Kansas City, Mo., has decided to reconstruct its horse car line on Broadway and equip it as an electric line if the consent of the property owners can be secured and the consent of the city council given. The line is about two and five-eighths miles in length and is one of the oldest lines in the city. It is at present the only remaining horse car line in the city proper, the other ones being out in the suburbs and used as connecting lines with the cable roads.

It is proposed to build an electric railroad along the Rhode Island shore to connect the summer resorts of Narragansett Pier and Watch Hill. During the year just passed an electric trolley road was operated from a point opposite Watch Hill to Westerly, R. I., and its success has brought up again the old project for a railroad connecting these two summer resorts. There would seem to be a very good likelihood of securing a large and profitable traffic for this line during the summer excursion season, which begins early at both these places and lasts until late in the fall.

## LEGAL DECISIONS.

The occupation of a rural highway, the fee of which belongs to the abutting owners, by a telegraph company, for the erection of its poles, is an additional burden to the easement for a highway, for which the owners of the fee are entitled to compensation, according to the ruling of the Court of Appeals of New York in the case of Eels against American Telephone & Telegraph company.

The Court of Civil Appeals of Texas has decided in the case of the Paris Electric Light & Railway company against the Southwestern Telegraph & Telephone company that where a telephone company, pursuant to its franchise, erected poles and strung wires thereon, an electric light company, whose franchise was granted afterward, may be enjoined from placing its wires in such close proximity as to impair the efficiency of the telephone service.

An interesting decision has been made in St. Louis in the case of the city against the Western Union Telegraph company over the terms of an ordinance governing the erection of telegraph poles in streets. In the Circuit Court for the Eastern District of Missouri the case was recently argued. Briefly stated the subject under consideration was this: "A city ordinance authorizing the erection of telegraph poles in the streets required any company erecting poles under its provision to file an agreement permitting the city to use 'the top cross-arm of any pole erected, or which is not erected,' for telegraph purposes, free of charge. A company which had previously erected its poles in the streets filed the agreement required, and thereafter acquired and erected additional poles." The court decided that the ordinance, so accepted by the company, constituted a contract between the city and the company, which became executed when the city took the benefit thereof by using the poles; and the subsequent imposition by the city of a certain charge per pole for the use of the streets was a violation of the contract.

## MISCELLANEOUS.

The new Westinghouse works at Brinton, Pa., will soon be ready for operation. It is said that the change will involve some changes in the office force of the company.

A party of Sioux City, Ia., and eastern capitalists has secured options on a right of way for a canal which is gigantic in proportions. The scheme is to make a canal from the Missouri river, tapping the river five miles above Elk Point, S. D., straight across the country, eight and a half miles, and emptying into the Sioux river. The projectors claim they will have a fall of 28 feet, which will give them 4,000 horse power. The canal will be 12 feet wide at the bottom. Three gates will be put in on the Missouri end. To prevent the river cutting at the mouth, a pile and concrete wall is to be built. The floor of the lock at the mouth will be made of matched oak, 6 by 6, interlaced by piling driven 15 or 20 feet deep. The gates are to be of steel. At this point on the Missouri the projectors claim the river has a force equal to 50,000 horse power. The object of this canal is to furnish power to run an electric light and power house plant, to light Sioux City, Akron, Elk Point, Yankton and other towns, to charge storage batteries and furnish power for small manufactories as well as to the Sioux City street car lines.

E. S. Jenison, a civil engineer of Chicago, is exploiting a plan to electrically transmit the power of the St. Louis and Cloquet rivers, near Duluth, Minn. The plan is an ambitious one, and Mr. Jenison thus describes it: "The Minnesota city is built at the foot and on the slope of a hill which rises for 650 feet. Beyond is a plateau. It stands at the head waters of Lake Superior and on the St. Louis river, which is 175 miles long. The St. Louis river has its source in the Mesaba range, and drains 39,000 square miles of swampy land. It is our intention to utilize this water. We will build a dam 1,900 feet square near the town of Cloquet, thirteen miles from Duluth. In this will be stored the waters of the St. Louis and Cloquet rivers, the latter of which is tributary to the former for sixty miles. The reservoir formed by the St. Louis will cover about forty square miles, which land will have to be purchased. This reservoir will extend to within five miles of the Mississippi river by the way of Sand Lake. At some points this body of water will inundate about 300 acres of the Fond du Lac reservation. This is the land we shall ask Congress to set a price on so that we may buy it. From the great resvoir we will build a canal to Duluth. The construction of the canal is by far the most considerable part of the enterprise. By the harnessing of Niagara a horse power of about 100,000 is obtained, while by our plans we expect to get as much as 600,000 horse power. The Niagara concern calculates that it can furnish power at a distance of 300 miles with a loss of but 15 per cent. We await the result of the experiment. If the test is successful we can carry power into Chicago, a distance of 400 miles, and on account of the much smaller cost afford a larger loss. In Chicago one horse power costs anywhere from $25 to $100 a year at the present time. We will be able to furnish power for $25 as a maximum for one horse power per year. A proposition has been made to the people of Duluth to furnish power for $10 a year. For a market we have Superior and Duluth. In these cities 45,000 horse power can be utilized annually. The benefit to Duluth can scarcely be estimated."

## TRADE NEWS.

The Hicks Gas Engine company of Cleveland, O., has issued a pamphlet describing its compound cylinder gas and gasoline engines. These engines have proved very successful wherever they have been installed.

Manager J. Stedman of the Chicago office of the Page Belting company has recently closed a contract with the Akron & Cuyahoga Falls Rapid Transit company, Akron, Ohio, for some large belts. As western manager of the Page Belting company, Mr. Stedman has been remarkably successful, and the Akron & Cuyahoga Falls contract is but one of a large number which he has landed this fall.

*Industry* of San Francisco mentions the fact that it has received upward of 200 favorable letters from students following the course of the correspondence school at Scranton, Penn. The same journal pronounces the system "the most original agency for technical education that has ever been devised, capable of an extension that has no visible limit, and portends a time when we will not set off a few of the most fortunate for education, but educate all up to the limits required in the application of the skilled arts."

The Berlin Iron Bridge company of East Berlin, Conn., will furnish the new power station for the United Electric Light & Power company on East Twenty-eighth street, New York city. The power house is 100 feet wide and 200 feet long; the engine room is 100 feet wide and 80 feet long, and the boiler room is 56 feet wide and 100 feet long, the whole covered with the Berlin Iron Bridge company's patent anti-condensation corrugated iron roofing. The coal pockets in the boiler room have a capacity of 3,000 tons.

J. H. Bunnell & Co., New York, have just gotten out their new edition (No. 14) of their general catalogue of telegraph, telephone, railway and electric lighting supplies, as well as of phonographs, graphophones and other devices in which electricity is an essential factor or connected with in the remotest way. They have endeavored to make this edition as complete as possible, the object being to present in the neatest, most compact and comprehensive manner the facts and figures contained in its 225 pages and nearly 750 illustrations.

The Mather Electric company of Manchester, Conn., has just concluded arrangements with Manning, Maxwell & Moore of New York and the Niles Tool Works of Hamilton, Ohio, for a large amount of new machine tools, which will be installed in the Manchester plant at once, and which are especially adapted for the building of large direct-connected and belted generators, which the Mather company is now making quite a specialty of. The plant at Manchester has been running over time with full force for the last two months, and the company now has orders on hand to keep the entire plant busy from four to five months.

It is interesting to note the revival of business in many lines, particularly in the manufacture of transformers. The Wagner Electric Manufacturing company, St. Louis, finds it necessary to build an addition to its factory. The company has been working in its transformer department three nights in a week, endeavoring to keep ahead of its orders. With increased floor space its facilities for manufacturing transformers will be greatly increased, and it will then be able to take care of promptly and ship from stock any reasonable size order that it may be favored with. The company has recently booked some very large orders, among them one from the La Roche Electric Works, for the new plant at Atchison, Kan. It has opened an office at 15 Federal street, Boston, Mass., with R. O. Hood, late of the General Electric meter and transformer department, in charge. All New England business in the future will go through his hands.

Elmer G. Willyoung has just returned from a two months' visit to England, where he has consummated arrangements for acting as the sole American agent for Messrs. Nalder Bros. & Co., London, the largest manufacturers of electrical instruments of precision in the world. He will also act as the agent for James White, Glasgow, Scotland, maker of Lord Kelvin's balances and electrostatic measuring instruments, and for L. Oertling, London, analytical and assay balances. Mr. Willyoung, who was for six years the electrical expert of Queen & Co., is generally recognized as the first to seriously take up in America the manufacture of electrical instruments of precision, and is the author of many improvements and refinements in electrical measuring instruments. It is the intention of Nalder Bros. & Co. and James White to make as rapidly as possible such modifications in the design of their instruments as shall better adapt them to the needs of American users, and new instruments, especially fitted for American practice, will be designed and brought out as rapidly as possible. Clayton W. Pike, formerly of Queen & Co., will be associated with Mr. Willyoung.

## BUSINESS.

Word has been received from General Manager Campbell Scott of the Louisville Electrical Works, Louisville, Ky., that Frank Culver, until recently assistant electrician of the National Electric company of Eau Claire, Wis., has associated himself with the Louisville Electrical Works as superintendent and electrician. Mr. Campbell is to be congratulated upon this new acquisition to his staff. The Louisville Electrical Works manufacture electrical and mechanical specialties, and the company also does considerable work in the line of repairing electrical machinery. It also does general machine work as well as considerable manufacturing in brass.

The Clayton Air Compressor Works, Havemeyer building, New York, have issued a new publication on the "Uses of Compressed Air." This list cites about seventy different applications of air under pressure, and is a most convincing commentary upon modern advancement in engineering, manufacturing and industrial lines. It is of especial interest to engineers, railroad men, machine and construction shops, marble and granite works, chemical works, sugar refiners, rubber and silk mills, tinware, pipe and hose manufacturers, and to all industries which use artesian wells, automatic sprinklers for fire protection, oil for fuel, and to physicians, hospitals or baths that use sprays for curative purposes. The list is mailed free on application.

The heavy demand for "O. K." weatherproof wire during the last few months has taxed the ability of the Electric Appliance company to keep up its stock, and as each carload is received it seems to melt away before it can be placed in position in the stock room. Even with a continuous procession of several carloads under way it has been impossible to supply the demand. It became very apparent therefore that some scheme must be devised for bringing the stock up to a satisfactory point and holding it there. New arrangements looking to this end have just been completed, and the Electric Appliance company assures its customers that a few weeks will see it in a position to fill any kind of an "O. K." wire order from Chicago stock or they will "know the reason why."

The large switchboard recently built for the Worden Tenement Mill building in Philadelphia, Pa., by J. Grant High & Co., 123 North Third street, Philadelphia, is made up of slabs of white Italian marble and is 10 feet high, 1½ inches thick and 30 feet long. On the lighting end of the board are mounted 34 150 ampere double pole switches and 146 auxiliary switches for fusing, with two 1,500 ampere switches for feeders. On the dynamo end of the board are Westinghouse ammeters and three Westinghouse voltmeters. On the bottom of the dynamo board are mounted three rheostats of the Carpenter style with flush face, and in the center of the board are six 700 ampere switches and three single pole and three double pole and three small 30 ampere single pole switches. On the back of the board are mounted three sets of copper bus-bars and connections, weighing in all nearly 2,500 pounds. This board is one of the largest of its kind in an isolated plant in the East and reflects great credit on the builders. The Chicago office of J. Grant High & Co. is at 807 Medinah Temple.

Colonel S. G. Booker, who recently surprised the electrical trade by his quick organization of the Phœnix Carbon Manufacturing company, St Louis, visited Chicago last week. When interviewed by a representative of the WESTERN ELECTRICIAN Colonel Booker was in the best of spirits and stated that the outlook for his new company was most encouraging. As is well known, Col. Booker was the leading spirit in the old Fidelity Carbon company of St. Louis, and it is safe to say that there is not an electric light man in the United States who does not know him. His energetic and aggressive efforts brought him early into prominence in the carbon business and he is now recognized as one of the most experienced and skilled carbon manufacturers in the country and also as one who has not only done most excellent work improving the quality of carbon goods, but likewise as a man thoroughly business-like and commanding the confidence of the large number of friends who purchase goods from him. It will be appreciated, therefore, that the Phœnix Carbon Manufacturing company is, as far as the quality of its goods is concerned, not a new concern, and purchasers of carbons who did business with the old Fidelity Carbon company will find in the goods of the Phœnix company now turned out under Col. Booker's superintendency the same evidences of skill in improvement as was peculiar to the product of the old Fidelity Carbon company. The carbon business cannot be mastered in a day, and Col. Booker's experience, it is needless to say, is one of the best assets of the new company, and its continued success may be looked for. Mr. Booker has associated with him as secretary and treasurer of the company Henry L. Page.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued November 20, 1894.*

529,354. Contact Device for Overhead Electric Railways. J. L. Blockwell. New York, N. Y. Application filed September 15, 1888.

Upon the roof of a car is placed a mast or pole provided at its upper end with a contact for engagement with a supply wire, and having at its lower end a transversely traveling connection with the car through a guide and traveler, movable freely along the guide.

529,363. Electric Switch or Cut-out. John C. Cassidy. East Orange, N. J. Application filed August 11, 1894.

The object of this invention is to secure a switch and cut-out by means of which all lamps or any one of them, or a series of lamps, forming part of a chandelier or electrolier may be turned on or off with one turn.

529,373, Electro-magnetic Apparatus. Stephen D. Field, Stockbridge, Mass. Application filed July 24, 1894.

The essential features of the invention are a polarized electro-magnet possessing high electrostatic capacity between its terminals, and consisting of a horse-shoe permanent magnet with superficially large pole pieces, and a single main circuit coil or helix surrounding both pole pieces, in combination with means for reducing the self-inductive reactance, and aiding the working efficiency of the main line coil.

529,385. Electric Fan Motor. Frank N. Hofbauer, Newark, N. J. Application filed August 1, 1894.

The motor may be operated by two to six cells of a gravity battery.

529,398. Audible Synchronism Indicator. Ralph D. Mushon, Pittsburg, Pa. Application filed April 27, 1894.

The invention consists in the method of indicating the occurrence of synchronism between two circuits in converting the electric vibrations in the two circuits into corresponding magnetic vibrations, thereby producing two distinct magnetic poles and subjecting a polarized body, capable of vibration, to the action of the poles.

529,399. Audible Synchronism Indicator. Ralph D. Mushen, Pittsburg, Pa. Application filed November 20, 1894.

The invention depends upon the electric interference or coincidence of the alternating current waves produced by the two machines to be synchronized, and the electrical conditions thus set up are interpreted to the ear by means of a diaphragm of any well known type such as is used in telephones, subjected to the action of the magnetic field resulting from the action of the interfering electrical waves. In the drawing the machine to be synchronized is shown at *2*, and the machine with which it is to be synchronized is represented at *1*. It will, of course, be understood that either of these machines may be a motor or both may be generators. The switch whereby they are connected on occurrence of synchronism is shown at *3*. In practice a coil *4* is employed, which is placed in series with the two machines, and which is made to surround a core *5* or other magnetic body for the production of a single magnetic field. The sound is produced by means of the diaphragm *6*, which may be provided with a sounding box *7* for increase of sound.

529,406. Underground Electric Railway. Henry B. Nichols and Frederick H. Lincoln, Philadelphia, Pa. Application filed June 13, 1894.

This invention may be described briefly as an underground structure, comprising columns supporting a roadbed, track rails and frames, the latter reversely arranged to constitute a slotted contracted chamber communicating with an enlarged lower chamber, racks supporting supply or feeder wires, and an electric conductor in the lower chamber supported by insulated cross guys to the structure out of alignment with the slot of the contracted chamber.

529,411. Manufacture of Electric Conductors. John Robinson, Philadelphia, Pa. Application filed February 16, 1894.

The process described consists of the method of applying to an insulated wire, while in a moist or wet condition, fibrous material, such as cotton, then applying a cord or thread thereto and subjecting the covered and corded wire to an insulating bath and thoroughly saturating it to produce an insulating electric conductor.

529,412. Insulated Electric Conductor. John Robinson, Philadelphia, Pa. Application filed February 17, 1894.

The conductor is composed of a wire provided with a coating of insulating material having a smooth surfaced covering of cotton, a binder of cords or threads in regular sequence wound around the wire, and a coating of insulating material permeating the body of the covered and corded wire.

529,413. Manufacture of Electric Conductors. John Robinson, Philadelphia, Pa. Application filed March 6, 1894.

In this invention an electric conductor is formed by continuously drawing a rotated wire through a bath of insulating material, and while still moist applying and compacting fibrous material, such as cotton, then cording the insulated and covered wire and laying it up for subsequent treatment or use.

529,421. Multiple Switchboard System. Charles E. Scribner, Chicago, Ill. Application filed May 1, 1890.

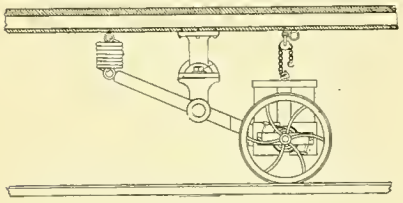
This invention relates to that class of multiple switchboard systems in which the telephone lines are provided with test circuits so arranged that when a line is in use it is crossed or connected with its test circuit, the absence or presence of this cross being determined at any board by connecting a telephone and battery with the test piece of any line.

529,429. Electric Incandescent Lamp. Elihu Thomson and Edwin W. Rice, Jr., Lynn, Mass. Application filed February 2, 1892.

These lamps are suitable for operation with multiphase currents or the systems in which waves successively lagging or shifted in period are used on three or more lines or mains. Such a system may feed its lamps directly or through multiphase transformers. It is claimed that great adjustability and high economy are obtainable in the illuminating power of the lamps, and a sixteen candle power lamp may be run down in candle power through a number of stages without loss of efficiency, as the filaments are not run at a dull red, so as to give much heat with a large consumption of energy and little light.

529,433. Electrical Measuring Instrument for Switchboards. John Van Vleck, New York, N. Y. Application filed April 18, 1894.

In the accompanying drawings Fig. 1 represents a face view of a portion of a switchboard showing two series of instruments, the instruments in each series being placed side by side, so as to expose their curved edges, on which are marked the scales. Fig. 2 is a side view. Each electrical measuring instrument has its scale and pointer upon one edge instead of having them upon its broad face, and is provided with means of attachment to a switchboard. The invention consists in the combination of a series of instruments so formed with a switchboard and placed together on the switchboard in such relation that the exposed edges shall all lie in the same plane or substantially the same plane, presenting to the eye the several scales side by side, so that all can be seen at once. These scales are graduated from bottom upward, so that the positions of the several pointers or indices on these scales, rela-



NO. 529,563.

tively to one another, may be seen at a glance, and the observer may recognize the fact that those indexes or pointers which are higher up than others indicate an increase, for example, in electromotive force or current strength.

529,434. Electrical Measuring Instrument. Edward Weston, Newark, N. J. Application filed October 3, 1892.

The movable coils are balanced upon opposite arms of a vibrating lever, which is supported by the pivot shaft, which in turn carries the index needle over a suitable scale. The movement of the pivot shaft is opposed by coiled springs. Two fixed coils are arranged in inductive proximity to the movable coils, and have their faces parallel to the plane of the movable coils, by which arrangement the coils are brought into such position that their fields will most strongly react at the beginning of the establishment of the current.

529,435. Electrical Measuring Instrument. Edward Weston, Newark, N. J. Application filed June 21, 1894.

The invention consists more especially in the construction and arrangement of the case of the instrument and in the disposition of the working parts, whereby the facility of manufacture of the apparatus is increased and the relation of the several portions thereof made certain and definite. The case is made of quite thin iron, which completely incloses all of the working mechanism of the instrument, but which has a slot or opening extending longitudinally through its convex face. Such a case is not only very strong and rigid, but it serves as a magnetic screen, preventing the effects of induction upon the magnets inclosed within.

529,437. Armature Core. James J. Wood, Fort Wayne, Ind. Application filed August 21, 1894.

The advantages claimed for this form of construction are the following: Little or no tendency to generate current in the bolts; greatly increased ventilating surface due to the hooks which engage the bolts; economical construction, since the waste of iron in making the punchings is reduced to the minimum; the punchings when assembled tend to hold each other and tie the entire structure together, so that no greater strain is thrown upon the spider than if the punchings constituted complete rings; the mechanical construction is the simplest possible, requiring no heavy spiders and no expensive planing or fitting, but a mere easy slipping together of the punchings over the fastening bolts.

529,451. Combination Gas and Electric Light Fixture. Gustav A. Loeben, Philadelphia, Pa. Application filed June 7, 1894.

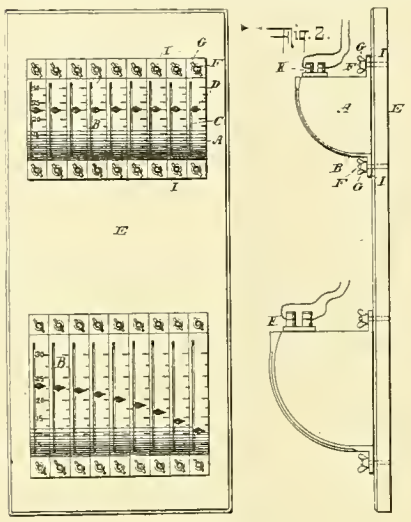
It is proposed to provide a pivotal flexible joint for use with combination gas and electric light fixtures, or for brackets, or fixtures intended for use with electric light only, that will remove all danger of injuring the electric conductors, or insulation by swinging or pushing the fixture to and fro, and to provide a joint whose construction will prevent wear and abrasion of the electric wires connecting the fixture, and which will be effective in its operation, simple in construction and inexpensive in manufacture.

529,461. Method of and Means for Synchronizing Alternating Current Motors or Generators. Henry Noel Patter, Allegheny, Pa. Application filed May 3, 1894.

The invention depends upon the interference or coincidence of the magnetizing effects of two circuits derived from the circuits to be connected when in synchronism. In practice these magnetizing effects are made to act upon a single magnetic motor pole, and the invention is thus distinguished from that form of audible synchronizer wherein two motor poles are formed, and wherein the mechanical interference of these two poles is relied upon to indicate the condition of the two circuits.

529,465. Telephone System. John I. Sabin, San Francisco, Cal. Application filed April 14, 1894.

The invention relates to telephone systems with bridged substation apparatus, and its object is the provision of means whereby the sub-station apparatus of two or more subscribers may be connected with a single telephone line, the sub-station apparatus being under the control of the operator at the central station in such a manner that the telephone line may be placed at the exclusive use of any one of said subscribers so connected.



NO. 529,433.

529,484. Printing Telegraph. B. A. Fiske, U. S. Navy. Application filed October 13, 1888.

This invention consists in a printing telegraph, the combination of a type-carrying device, a series of adjusters, each of which independently of the others and independently of the press mechanism, moves the type-carrying device to a position for printing, the spaces of adjustment collectively being commensurate with its maximum range of movement.

529,552. Trolley Stand. Frank N. Kelsey, New Haven, Conn. Application filed August 29, 1894.

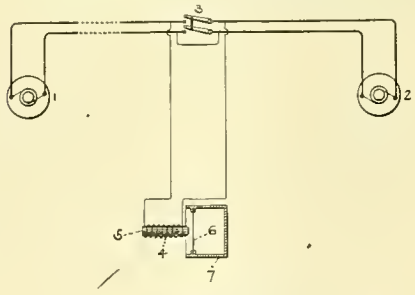
It is proposed to provide stands used on electrically propelled cars for supporting and applying the proper amount of tension upon the trolley arm, which will equalize the tension upon the trolley arm in such manner that the tension will remain substantially the same, regardless of the angle at which the arm stands, thereby preventing undue strain upon the trolley wire at points where its level is much depressed below its normal level, and materially prolonging the effective life of the springs by which the tension upon the arm is produced.

529,532. Switching Apparatus for Incandescent Electric Lamps. Charles E. Scribner, Chicago, Ill. Application filed April 23, 1889.

The object is to provide for the turning off or on an incandescent lamp from two different points. For example, in staterooms one lamp has been provided with a switch for turning it off and on at one only of two berths. By the use of this invention the occupant of either berth may turn the lamp off or on by simply moving a switch.

529,559. Electric Circuit. Joseph W. Marsh, Pittsburg, Pa. Application filed April 10, 1894.

The electrostatic capacity of the conductors and retardation resulting therefrom shall be reduced, while at the same time the circuit is suitable for use out of doors and in other places where there is danger of short-circuiting by moisture.



NO. 529,399.

529,563. Apparatus for Generating Electricity for Lighting Railway Cars. Thomas A. Murray, Boston, Mass. Application filed May 3, 1894.

The cut represents a sufficient portion of a steam railway car provided with an electric generating apparatus embodying this invention, the railway car being represented in section. The dynamo is carried by a frame pivotally supported, so as to enable it to be moved bodily in a circle about the pivot, and the dynamo-carrying frame for the best results is also capable of lateral movement with relation to its pivotal center, so as to enable the dynamo-carrying frame to be moved sidewise, as when the car is rounding a curve in the track. The armature shaft is rotated by means of wheels traveling upon the rails of the track. Two wheels engaging opposite rails of the track are used, but a single wheel engaging but one of the rails could be used. The dynamo-carrying frame may be pivotally secured to the car body, but if desired it may be secured to the truck frame.

529,578. Switch. Francis B. Badt, Chicago, Ill. Application filed October 14, 1892.

This device is an air-tight switch in which connection will be made and broken in an air-tight chamber. In the cut is illustrated a cross-section of a modification, showing a long interval between the terminals. *A A* are the terminals of main wires which are to be connected, and *B B* are the short conductors connected therewith and associated with the switch, whereby the circuit through the mains, including the mains, may be opened or closed. These short conductors lead to insulated terminals *C C*, which pass through the sides of the air-tight chambers *D*. The air-tight chambers *D* are pivotally supported on the standards *E E*, and are associated with the thumb-pieces *F F*, whereby such chambers may be rocked or turned upon their pivots, so as to assume different positions. These chambers may be variously shaped, but they are shaped so that a liquid partially filling such chamber will be in contact with both terminals when the chamber is in certain positions, but will not be in contact with both terminals at other times. *G* is a conducting liquid in such chamber. *H* is a flat spring bearing against the square side of the shank *J* of the thumb-piece *F*, whereby such shank is normally kept in the position at which it is left, so that the chamber is elastically locked in either position.

529,595. Electric Switch and Cut-out. John C. Cassidy, East Orange, N. J. Application filed September 24, 1894.

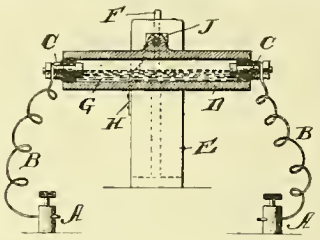
An electric switch and cut-out, consisting of a frame having a bar, to which is rigidly fixed an insulated block carrying a contact surface fastened thereto by means of screws, a connecting spring, said connecting spring being of conducting material, all in combination with an insulated collar and wheel having an insulated surface and a contact surface, one-half which contact surface is corrugated and the other half smooth. The corrugated surface and smooth surface are of one piece, in combination with a collar and an insulated block carrying contact pieces which are fastened to a block by means of the screws, said block being fastened to the arm of the frame, this arm carrying a neck in combination with a rotary shaft, and a finger piece so arranged that the rotary shaft will cause the wheel to revolve, so as to present the insulated surface of the wheel or the contact surface of the wheel to the connecting springs.

529,609. Antiseptic Mouth-piece for Telephones. Rial N. Denison and Frank M. Geary, Brooklyn, N. Y. Application filed April 25, 1894.

This device is a mouth-piece for telephones and speaking tubes, consisting of an inner and an outer shell united to form an intervening chamber, the inner shell being perforated, and an antiseptic material located within this chamber.

529,616. Section Insulator. A. Hennefeld, Christ. Dehner and Charles H. Van Ness, Colorado Springs, Colo. Application filed April 19, 1894.

The invention is to provide a simple and effective trolley wire break, which may be inserted in the line at any time without interfering with traffic, and without the necessity of slackening the line, and consists in a curved bar of wood or other insulating material, provided at its ends with metallic tips, and furnished with means for mechanically connecting the ends of the trolley wire and for engaging the span wire.



NO. 529,578.

529,630. Printing Telegraph. George A. Scott, London, Eng. Application filed September 6, 1887.

The invention consists in part of improvements in the receiving or printing instruments of printing telegraphs worked with three or more wires, or on synchronous systems, or on synchronous multiplex systems, which improvements consist essentially of a series of magnets or solenoids, having their armatures or cores so arranged relatively to a flexible connection or flexible connections secured to or engaged either directly or indirectly with the type wheel or the shaft thereof, or so arranged relatively to mechanism, connected to or engaged with the type wheel or its shaft, that the part or the wheel bearing any required letter or character may be turned or permitted to turn round to the printing point by opening or closing the circuit of a battery or the circuits of batteries through the coil or coils of one or more or all of the magnets or solenoids.

529,650. Continuous Current Dynamo-electric Machine. M. Hutin and M. Leblanc, Paris, France. Application filed February 12, 1894.

The object of this invention is to prevent the generation of Foucault currents in the field magnets of continuous current dynamo-electric motors or generators by the sudden variations of magnetic flux which occur in such machines for a variety of reasons.

529,654. Electric Light Fixture. John R. Kenetshing, Brooklyn, N. Y. Application filed February 21, 1894.

This fixture is a combination of a suitable base, a reel contained therein, flexible conductors wound upon the reel, a removable lamp-holder arranged to fit over and embrace the base, a fastening device for removably securing the lamp-holder to the base, and a lamp carried by the lamp-holder and connected directly with the free ends of the flexible conductors wound upon the reel.

529,671. Gearless Electric Locomotive. Charles J. Van Depoele, Lynn, Mass. Application filed June 3, 1891.

The invention relates to improvements in the mounting of electric motors with respect to the axles and wheels driven thereby, and it refers particularly to that class in which the revolving part of the motor surrounds the axle, and resilient power transmitting and supporting connections are interposed between the said motor and the driving wheels. The motor is mounted upon a sleeve which surrounds the axle and the revolving part of the motor, whether armature or field magnets, is fixed upon the sleeve. The stationary part of the motor is either journaled upon the sleeve or so constructed as to allow the sleeve to rotate freely therein. The sleeve is considerably larger upon its interior than the diameter of the axle, so that there may be movement of the axle within the sleeve. The sleeve is connected to flanges or rims upon the driving wheels near their peripheries by a resilient connection, and it is entirely independent of the axle, so that when the motor is imparting movement to the sleeve the driving power will be transmitted directly from the sleeve to the driving wheels through the resilient connections. The connections support the sleeve and motors carried thereby upon the wheels, but independent of the axles. By means of this combination the vibration caused by the wheels running over rough places in the track will not affect the driving motor or motors, the vibration being taken up by the said elastic connections.

# Western Electrician.

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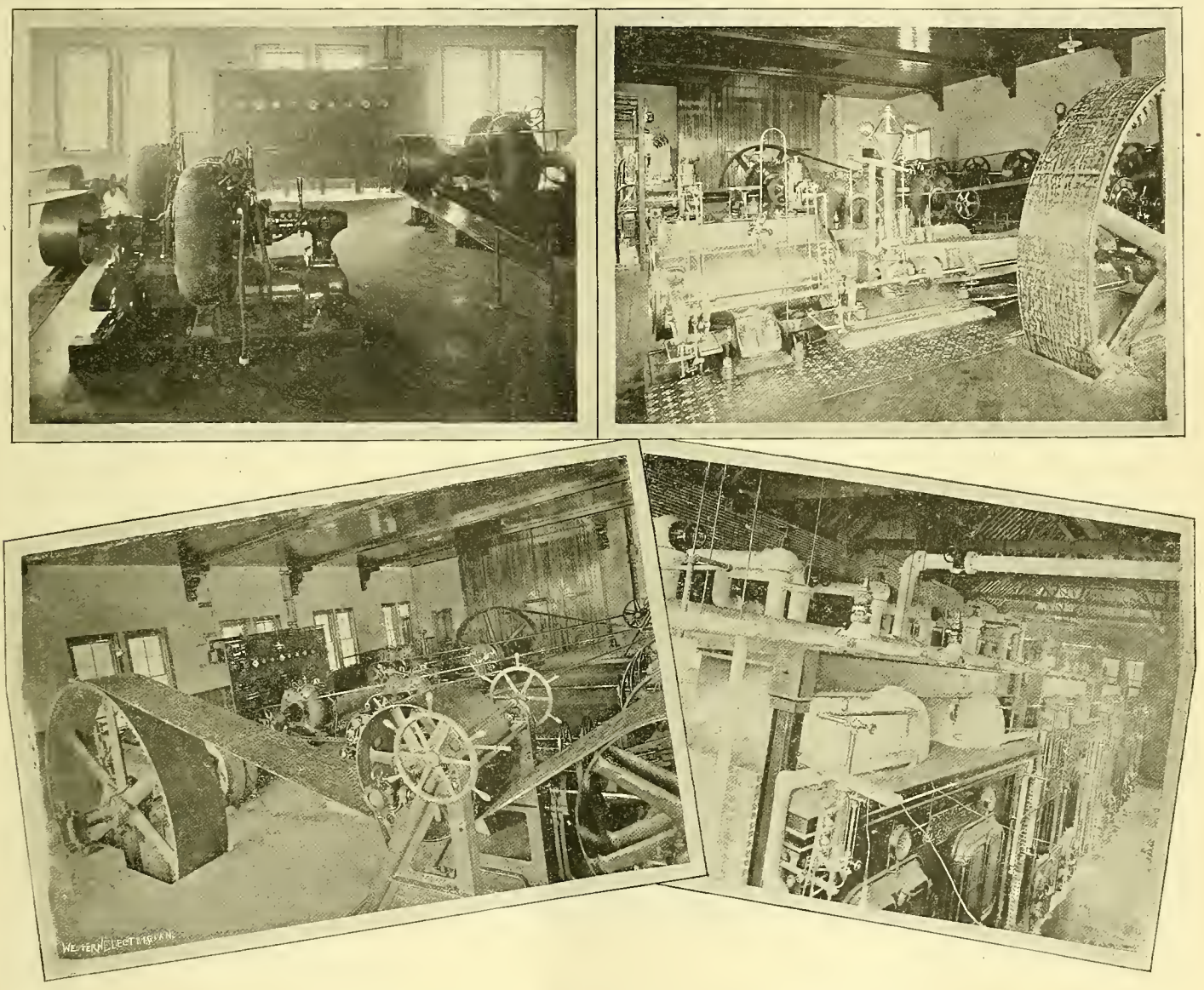
## Distribution of Light, Heat and Power at the Kalamazoo Insane Asylum.

A central plant for supplying light, heat and power to the various departments of the Michigan Asylum for the Insane at Kalamazoo is now nearing completion. The installation has been carefully planned, is of large size and possesses several features of unusual interest and value to those contemplating the erection or improvement of similar concentrated power plants. The accompanying series of illustrations and diagrams will be of material assistance in enabling the reader to comprehend the scope and details of the system.



Lighting Dynamos, Generator and Switchboard.
General View, Showing Belt Connection.

General View, Showing One Engine.
Boiler Room.

FIG. 1. DISTRIBUTION OF LIGHT, HEAT AND POWER AT THE KALAMAZOO INSANE ASYLUM.—INTERIOR VIEWS OF POWER HOUSE.

### INCEPTION OF THE PLAN.

To understand clearly the conditions to be met in designing and operating the power plant, a few words descriptive of the general characteristics of the institution are necessary.

The Michigan Asylum for the Insane is a large state institution located on rolling ground about a mile and a half from the center of the pleasant little city of Kalamazoo. The relative position of the main buildings is shown by the outline map, Fig. 3. The beginnings of the asylum date back to the 40's, but the first building for the reception of patients was not ready for occupancy until 1859. This is the building now devoted to the female department and containing the principal offices of the institution. With the growth of population—perhaps, unfortunately, in even greater proportion—the number of patients in the asylum has steadily increased, until now about 1,170 persons in various stages of mental disease are sheltered in the institution. These unfortunates come mainly from nineteen contributory counties in Southern and Western Michigan and are nearly all supported at public expense. With the passing years the asylum has been extended in various directions, until now the trustees have under their supervision about a million dollars' worth of property, including 850 acres of land and 32 distinct buildings. The latter include the two main buildings (male and female wards), chapel and amusement hall, water tower, power house, shops, stores, etc., shown on the map, as well as cottages, barns and other buildings on the asylum farm, two and one-half miles distant from the main establishment. The man in active charge of this considerable community is Dr. William M. Edwards, who, with the title of medical superintendent, combines in a striking manner the characteristics of a skillful physician and an admirable executive. Dr. Edwards has been with the institution for eleven years and is, of course, thoroughly conversant with every detail of the work under his supervision. He has long been impressed with the importance of the concentration of the power plant under one roof, and the credit for the improvement is largely due to him.

In the summer of 1892 the project of erecting a central light and power plant for the institution was first broached by the trustees. At that time the cost of the coal and gas used in the asylum was over $20,000 per annum—$15,000 for power and heat and $5,000 for light. There were eleven antiquated boilers in three widely separated batteries. The situation was thus described in the report of the trustees for the biennial period ended June 30, 1892:

"The two main buildings, the male and female departments, stand on the top of a ridge about forty rods apart. Nearly midway between these two old, but main buildings, stands the new chapel and amusement hall; 1,100 feet behind and west of the latter and 100 feet below it, in the valley, is our water supply, concentrated in one large pumping well. A plant of five large boilers provides power and heat for the female department; another smaller plant of four large boilers provides similarly for the male department, and one small power plant, but separate and distinct and located beside the well in the valley, pumps all the water used from this well into cisterns on the hill, whence it is again pumped to tanks in the attics of the male and female departments."

The trustees strongly recommended a central plant, to be erected at an approximate cost of $58,000, to furnish all the light, heat and power for the asylum and to supersede the

scattered steam plants then in use. They were largely influenced to this conclusion by the opinion of Prof. M. E. Cooley of the mechanical engineering department of the University of Michigan, who, after a careful examination, made a report in which he said:

The principal causes for the excessive fuel cost which we may consider are to be found, first, in the use of separate boiler plants; second, in the use of several pumping plants; third, in the use of engine and pumps wasteful of steam; fourth, in the lack of feed-water heaters and purifiers; and fifth, in the condition of the boiler setttings and pumps.

The first cause—separate boiler plants—is a very important one. The saving to be effected by placing all the steam generators under one roof is recognized by engineers generally. The boilers may then be used to the best advantage. Often one will be found sufficient and one fireman can do the work which now requires three. The exhaust steam from the engine and pumps can be more efficiently utilized for heating or for dry purposes in the laundry. It is difficult to estimate the saving that might be effected by means of a central plant; but that it would be very considerable no one can doubt.

The next cause—engine and pumps wasteful of steam—is more easily explained. The engine now in use is a throttling governor engine with a plain slide valve. The results of numerous experiments show that this class of engines use about twice as much steam as the more modern forms of Corliss and automatic cut-off engines. Assuming that the engine develops from 40 to 50 horse power, the steam consumption is from 2,400 to 3,000 pounds per hour, which corresponds to from 350 to 450 pounds of coal; or in ten hours from 3,500 to 4,500 pounds, equal to about two tons per day, or 600 tons per year. A modern engine should save one-half of this, or 300 tons per year.

* * * * * * * * *

The present condition of the boilers and settings is such as to command immediate attention. The boilers are all old, some of them have been in use twenty years and more. They will probably need to be renewed in the near future. It should be carefully borne in mind that in incurring the expense of renewals, advantage should be taken of the benefits appertaining to a central plant. It would be very unwise, in my opinion, to expend from $10,000 to $15,000 for renewals in connection with existing plants and continue to experience losses which would much more than pay the interest on the entire cost of a central and modern plant.

The trustees also urged upon the Legislature the necessity of electric lighting and a generator for power transmission. The result of this movement was that the Legislature of 1893 made appropriations for a new power plant as follows: New boiler and engine house, $14,300; new boilers and setting, $18,700; for electrical machinery, $18,000; new engines and settings, $6,000; total, $57,000. At the same time the sum of $18,000 was appropriated for a water tower, to replace the cumbersome system of cisterns and tanks in the water distribution. Preliminary plans for the improvement were begun as soon as the appropriations were secured, and although subjected to many delays due to a desire to proceed cautiously, using none but tested and approved construction and apparatus, the work is now nearly completed. The result is a very complete and interesting plant.

FIG. 2. DISTRIBUTION OF LIGHT, HEAT AND POWER AT THE KALAMAZOO INSANE ASYLUM.—EXTERIOR VIEWS OF POWER HOUSE.

### POWER HOUSE EQUIPMENT.

As shown by the three exterior views grouped in Fig. 2, the power house is an attractive building of stone and brick. Its relative location and the conduit connections are shown on the map, Fig. 3. The ground dimensions are 107 by 116 feet and the brick octagonal stack is 162 feet high. The front portion of the building is taken up by the boiler room, while the two rear wings, which are separated by a passageway 17 feet wide, as shown by the view at the left in Fig. 2, are devoted to the engine and dynamo room and coal house respectively.

Interior views of the power plant are given in the photographic reproductions in Fig. 1. The boiler plant is surprisingly large, the aggregate capacity being no less than 1,200 horse power. This is accounted for by the fact that all the steam for heating the great asylum buildings is here generated as well as that required for power, while ample provision is made for reserve and for future growth. There are eight water-tube boilers, each rated at 150 horse power, in the engine room. These are grouped in four batteries, with fire-brick settings. The boilers are of the Wood type, made by Wickes Bros. of Saginaw, Mich., and each is 70 inches in diameter and 22½ feet long. They are hung from the top, the weight being supported by I beams set in masonry. A platform over the top of the boilers gives the workmen access to all the controlling valves. The boiler house is 104 feet wide and 42 feet deep.

Ohio soft coal is burned and is brought on the grounds on a spur of the Michigan Central tracks in the valley, from which it is hauled to the coal house by an electrically operated rope tramway. At present one battery is supplying steam at 85 pounds pressure for the engines driving the electrical machinery and for transmission to the laundry and the kitchens in the two large buildings. Steam is used for cooking purposes, the pressure being lowered to 40 pounds by a reducing valve. Another battery generates steam at low pressure (about two pounds) for heating purposes entirely, the transmission being through covered pipes in the underground conduits. The exhaust from the engines is also used to supplement the supply of low-pressure steam for heating, and during the severe winter weather an additional battery of boilers will probably be needed for this service. This still leaves one battery, or 300 horse power, as a reserve and for use when cooling down and cleaning is necessary. Indeed, the whole plant has been planned on a scale sufficient to secure immunity from any interruption of the service due to any conceivable break-down. The boiler pumps, feed-water heaters, etc., are in the basement under the engine room.

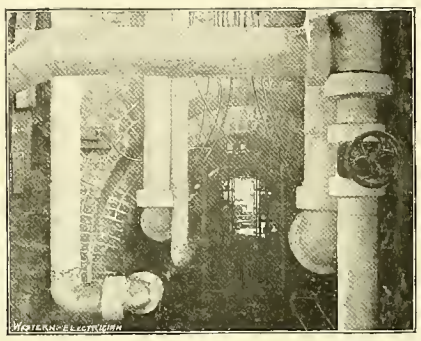


FIG. 4. DISTRIBUTION OF LIGHT, HEAT AND POWER AT THE KALAMAZOO INSANE ASYLUM.—STEAM AND ELECTRICAL CONDUIT.

The engine and dynamo room is 70 feet long and 42 feet wide. Three views of it are shown in Fig. 1. Two large, slow speed, horizontal engines are used to drive a line of shafting to which the dynamos are belted. These engines were made by the Nordberg Manufacturing company of Milwaukee, and they are imposing and handsome machines. The engines are duplicates, with single cylinders 16 inches in diameter, with 34 inch stroke. Operated at the highest efficiency, these engines have a capacity of 100 horse power at 85 pounds steam pressure, but it is said that they are capable of an output of 285 horse power each. Poppet valve gear is used, and the 11 foot flywheels are operated at 107 revolutions per minute. The line shaft extends along one side of the engine room, and is very completely provided with belt tighteners, clutch pulleys and the like. The shafting is designed to be interchangeable; that is, it can be thrown out of connection in the middle, allowing each engine to care for its half of the load independently, or it can be so arranged that either engine can drive any dynamo belted at any point on the line of shafting. Particular attention was paid to this feature, to avoid any contingency by which the institution might be left in darkness—an emergency which might, of course, be of serious consequence in an insane asylum. The shafting and all accessories were obtained from the Hill Clutch Works of Cleveland.

The most cursory glance at the engine room equipment reveals the fact that the greater part of the dynamo-electric machinery is of the familiar type of the C & C Electric company of New York, as shown by the upper left-hand view in Fig. 1. Four of the characteristic curved-magnet machines of this company furnish direct current for lighting and power transmission. The generator for power is an 80 kilowatt 500 volt machine, which operates all the motors used about the institution. There are also two 110 volt dynamos, rated at 800 lights each, which carry the lighting load of the two principal buildings, one for the male department and one for the female department. A small 75 light C & C machine is provided for the day load. As the distance to the farm is two and one-half miles, it was deemed advisable to put in an alternator to supply current for lighting the buildings in the distant portions of the grounds. This service is performed by a 1,000 volt dynamo supplied by the General Electric company.

The switchboard is of slate, with six panels. It is handsomely equipped and supplied with Queen & Co. and Thomson-Houston instruments and switches made by the Wallace Electric company of Chicago. The bus-bars are on the front of the board, which, as will be seen by the upper right-hand picture of Fig. 1, is placed out in the room a sufficient distance to give ample access to the back portion. A voltmeter transformer is used for the alternator. The electrical portion of the power house equipment has been carefully planned by Prof. F. C. Wagner of the University of Michigan, under the general direction of Prof. Cooley, who supervised the whole mechanical and electrical installation.

### CONDUITS.

All the wiring is carried underground, except the alternating current and power conductors for the farm, which are supported on poles. The location of the conduits is indicated on the map, while a photographic representation of the entrance to the one leading to the male department is shown in Fig. 4, and a cross-section drawing in Fig 5 (page 270). An important function of these large conduits is the transmission of steam for heating, cooking and laundry uses, so that in the case of each large building the conduit leads to the old boiler house to connect with the previously existing system of steam pipes. The conduit to the male ward is 786 feet long, while the length of the one leading to the female department is 396 feet. The conduits are, in fact, arched brick tunnels, a little over six feet in greatest width and of about the same height in the center. The floor is of cement. The steam pipes and electrical conductors are supported on iron pipe standards, with cross-bars fastened in the masonry and concrete at top, side and bottom, as shown in Fig. 5. The light and power wires are fastened on glass insulators supported on iron brackets above the steam pipes. The main steam pipes are twelve inches in diameter, and, including high pressure and return pipes, each conduit contains six pipes. All are encased in mineral wool covering furnished by the Chicago Fire-proof Covering company. The tunnels are lighted by incandescent lamps on an independent circuit.

### LIGHTING.

In all the plant has a capacity of supplying 2,175 incandescent lamps of 16 candle power. Of this capacity 1,675 lights can be carried on the C & C direct current machines and 500 on the alternator. The number of lamps connected is about 1,700. The conducting wires are all concealed from view, although carefully safeguarded from danger of fire. The cut-out boxes, also, are under lock and key, so that the patients cannot tamper with them. No arc lamps are used.

The work of wiring, both in the old buildings and the new construction, has been carefully done, and Okonite wire is used throughout. In the whole institution there is between 80,000 and 100,000 feet of this wire, embracing a variety of sizes, from the large feeders in the conduits to the smallest branches in the wiring system. The contract for supplying the wire to the asylum was eagerly sought and was secured by the Okonite people after a keen competition.

### USE OF MOTORS.

Electrical power transmission forms a conspicuous feature of the economy of the Michigan Asylum for the Insane.

Motors aggregating 160 horse power are scattered about the grounds operating in a very satisfactory manner the varied power machinery of the institution. The most important installation is in the pump house, a partial view of the interior of which is shown in Fig. 6. The pumping equipment is in the valley, back of the asylum, and the location is not shown on the map. The water supply is obtained from a number of connected wells, and the pump house is at the largest of these. Here are two large Knowles pumps, each with 8 inch cylinder and 12 inch stroke, to be directly connected to two 40 horse power, 500 volt C & C motors, as shown in the unit illustrated in Fig. 6, the other being not yet in position. These electrically operated pumps have each a capacity of raising 500,000 gallons in twenty-four hours. The water is at present pumped up to the system of cisterns and tanks to which allusion has before been made, but as soon as the new water tower is completed, it will be utilized as the reservoir and distributing point of the entire water supply system. This water tower is a conspicuous round brick structure, as can be seen by Fig. 7, and it forms a noteworthy feature in the landscape of the asylum grounds. It is to be surmounted by a steel tank 34 feet in diameter and 34 feet high, which will have a capacity of 236,000 gallons, about one day's supply for the institution. The water tower will be about 160 feet high when completed, with an ornamental top. It is of the same diameter as the tank which it will uphold, and the masonry supports are of a very substantial character. The total lift from the pump house to this tank is 230 feet, the distance along the surface of the ground being about 1,200 feet. With two 40 horse power motors and two 500,000 gallon pumps it will be seen that ample reserve power is provided. The motors will be connected so that they may be controlled from the switchboard in the power house. The water is forced up the hill through an eight-inch supply pipe.

At the farm, two and one-half miles from the power house, there is a 5 horse power motor on the 500 volt circuit which is also used to drive a pump.

In the laundry, in the rear of the female ward, a 20 horse power motor, Fig. 8, is belted to a shaft, from which several machines used in this department are driven. The work here is nearly all performed by female patients. A 25 horse power motor in the basement of the carpenter shop, shown in Fig. 9, drives, by means of belting and shafting, the saws, lathes, etc., on the floor above, on which the controlling switch and rheostat are placed. In the picture, Fig. 9, is shown the branch of the underground conduit through which the wires leading to this motor will be laid when the connections are complete.

A particularly interesting motor outfit is that shown in Fig. 10 (page 271), which represents the machinery used to draw the dump cars that carry coal up the inclined tramway leading from the railway tracks in the valley to the coal bunkers in the power house on the ridge. The inclined railway can also be seen in the left-hand picture in Fig. 2. For this purpose two old street car motors of the Thomson-Houston type, each of 15 horse power, are used. These are geared to a wooden drum, which, in turning, draws the loaded car up by means of a wire rope. The coal is loaded on the tramcars directly from the flat cars on the steam railway tracks at the foot of the incline. When one of the smaller cars is loaded the workmen signal the fact to the power house attendants, who start the motors at their end of the line and pull the car up. By this means much labor is saved.

GENERAL FEATURES.

It is too early yet to give comparative results of the economy of the present system of distributing the light, heat and power for the institution from one central station, as the plant is not entirely complete. The labor expense has already been materially reduced, however, and it cannot be doubted that the coal bill will also be lessened to a marked degree. When the plant is entirely finished and in smooth running order, careful records will be kept, and, when compared with the corresponding cost of the old system of heating and lighting, these will be of much interest and value. It is confidently expected that a great saving will be shown, leaving out of consideration entirely the uncontested superiority of the new system. In one thing the asylum trustees have been particularly fortunate, and that is in buying their equipment at a time when the business depression made competition so keen that the best apparatus could be obtained at exceptionally low prices. This fact was taken advantage of, and the equipment is a credit to the state in every respect.

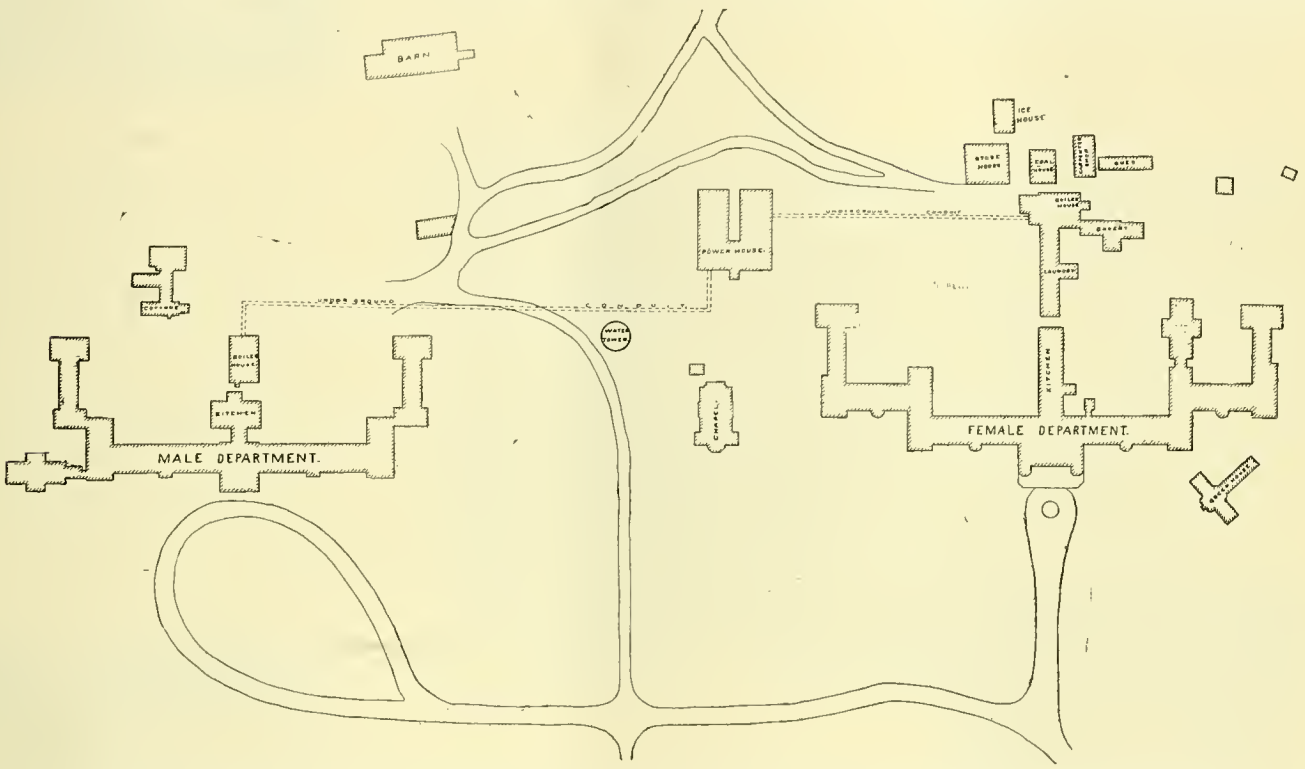



FIG. 3. DISTRIBUTION OF LIGHT, HEAT AND POWER AT THE KALAMAZOO INSANE ASYLUM.—MAP OF BUILDINGS AND GROUNDS.

It is proper to add, in closing, that nearly all of the electrical machinery was sold through the Chicago office of the C & C company, of which E. E. Mandeville is manager.

## Important Patent Decision.

Announcement has already been made of the decision of Judge Seaman of the United States Circuit Court for the Eastern District of Wisconsin, in the case of the Thomson Electric Welding company against the Two Rivers Manufacturing company and others. The action was a bill in equity by the Thomson company against the Two Rivers company and others for infringement of certain patents for electric welding. Complainant moved for a preliminary injunction. In his decision Judge Seaman said:

This hearing is on an order to show cause why preliminary injunction should not issue to restrain defendants from infringing letters patent granted to Elihu Thomson and owned by complainant, as follows: No. 347,140, issued August 10, 1886, relating to the art of electric welding, alleged to have been invented by the patentee, and apparatus used therein, No. 347,141, dated August 10, 1886, and No. 385,022, dated June 26, 1888, each for apparatus employed in carrying out this alleged new art. It is conceded by defendants that they have had ample time to present and that they have probably shown here all the defense they can make by affidavits and proof of the prior art. The complainant objects to the reception of two affidavits—one by George A. Johnson and one by Leo Daft—because they were brought in shortly before the hearing and long after the time stipulated for closing their proofs; but the delay seems to have been excusable and left opportunity (which was well improved by complainant) for rebutting affidavits. There being no request for further time to meet them, I deem it proper to let in these affidavits under the circumstances, and they are therefore taken into consideration for the purposes of the motion.

Since the argument in which the points upon each side were well and clearly presented, I have taken such time as I could spare to consideration of the record and briefs and have read with care all that has been introduced upon the part of the defense, and the impressions which came to me from the argument have not been changed. The invention is employed by the defendants in welding hoops for pails and tubs, and the infringement is unquestioned, and, upon the conceded facts, is deliberate and flagrant if the patents are valid. All defense rests upon the ground of anticipation or want of invention in the patents. This issue is frankly and squarely presented upon the part of the defendants, and I do not find any denial of complainant's showing that the patents were of great utility; that the alleged new art and apparatus were received and recognized by the world at large and by electricians and scientists as novel and important and the process immediately entered into wide use and revolutionized the methods of welding metals, especially where different metals were to be welded together; that manufacturers throughout the country have acquiesced in the validity of the patents continuously since their issue; that the great list of those who have operated under them embraces some of the largest in the country, reaches into all the manufacturing states, and there are apparently no contestants other than these defendants; that the defendants entered upon infringement after this general acquiescence and recognition and after obtaining full information from complainant of the process and apparatus and after refusal to accept license upon terms accorded to other licensees, which appear reasonable on their face and are not attacked as unreasonable; that the equities of complainant entitle it to an injunction *pendente lite* for the protection of its rights and business with licensees if the patents are valid or are to be considered valid for the purposes of this motion; that the issuance of an injunction would not close the works of defendants, but would simply turn them back to their former method of welding hoops for their manufactured wares. It is an established rule, for this circuit at least, that the injunctive powers of the court should not be exercised *pendente lite* against infringement of letters patent without some prior final adjudication of the validity of the patent or "such continued public acquiescence in the exclusive right asserted as raises a presumption of validity—a presumption not arising from the letters patent unless accompanied by public acquiescence." (Standard Elevator company vs. Crane Elevator company, 6 C. C. A., 100; 56 Fed. Rep., 718; Electric Manufacturing company vs. Edison Electric Light company, 61 Fed. Rep., 834.)

There has been no adjudication of the validity of these patents, and, so far as appears, no opportunity has arisen heretofore for testing their validity. Has there been public acquiescence in the claims here asserted of sufficient definiteness and duration to afford presumption of validity? This inquiry must depend in each case upon all the circumstances shown. Here was clearly an assertion of a new art and apparatus for welding. Its discovery was widely published and accepted by the scientific world in Europe and America and by the public generally as novel and important. It was speedily put into operation by the complainant, and its machines and rights for their use were at once sought by manufacturers and metalworkers, and it is unquestioned that the process had extended to an important share of the welding of metals throughout the country when the defendants entered upon its use. With an asserted invention of this character and utility and operation under it firmly established since 1888 and to a considerable extent supplanting the older methods, I am satisfied that there is a sufficient showing of public acquiescence and that "there arises such presumption of the validity of the patent as to en

title them to a preliminary injunction to restrain its infringement, unless the party sought to be restrained can clearly show its invalidity." (Blount vs. Société Anonyme, 3 C. C. A., 455; 53 Fed. Rep. .98; Sargent vs. Seagrave, 2 Curt., 553; Fed. Cas., No. 12,365; Sessions vs. Gould, 49 Fed. Rep., 855; 3 Rob. Pat., secs. 1185-1188.)

The remaining question is whether the defense have given a clear and convincing showing, first, that the invention was merely the double use or analogous use in the art of a process previously known, or, second, that it was fully disclosed in previous publications or patents and actually practiced as a welding operation prior to these patents, which should be held to overcome these presumptions and

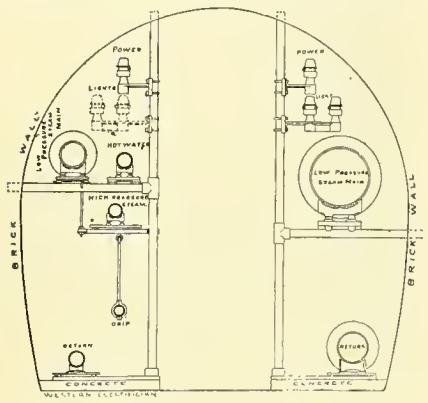



FIG. 5. DISTRIBUTION OF LIGHT, HEAT AND POWER AT THE KALAMAZOO INSANE ASYLUM.—CROSS-SECTION OF UNDERGROUND CONDUIT.

the reinforcing affidavits produced by complainants. Great research and ingenuity appear in this defense, but I am constrained to the opinion that neither proposition is maintained to the degree required for preventing an injunction, and that their determination must be postponed to final hearing. They present the story frequently interposed against valuable patents of laboratory experiments, of announcements, and of patents which may have come to the verge of this discovery; but the demonstrations are not clear, and the important fact stands in their way that they do not appear to have accomplished the electric weld which is shown by Thomson.

The employment of heat and pressure for the operation of welding metals is old, and it was long known that heat could be obtained by the application of an electric current. These were not Thomson's discoveries, but he found a method for employing the electric current, localizing the heat at the joint to be welded, and applying simultaneously the requisite pressure, so that the separate pieces of metal could be properly united. I am not satisfied, for the purposes of this motion, that he was anticipated in this by Despritz, Joule, Planté, Cruto, or any of the patents shown, or by any experiments of Daft or Johnson.

In this view the complainant is entitled to an injunction

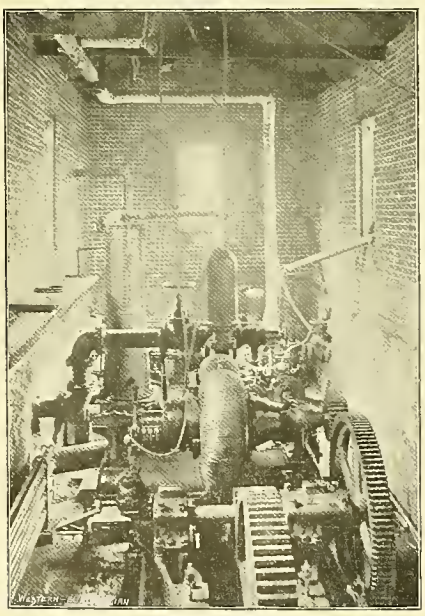


FIG. 6. DISTRIBUTION OF LIGHT, HEAT AND POWER AT THE KALAMAZOO INSANE ASYLUM.—ELECTRIC PUMP.

*pendente lite* against infringement of letters patent Nos. 347,140 and 347,141, and injunction will issue thereupon. With reference to letters patent No. 385,022, all determination will be postponed to final hearing.

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Even during the military crisis the erection of new spinning plants is serenely in progress in China. Some of the mills are being provided with the electric light, and there is every probability of an attempt being made to run the spindles themselves by means of electric power. In these respects the Chinese are said to be content with nothing but the best and the latest.

## Some Possibilities of the Storage Battery.[1]

By Pedro G. Salom.

There are few subjects that have excited more general interest and widespread speculation than that of the storage battery. From the wildest vagaries of the enthusiasts, who predict that, in the future, storage batteries will be so improved in capacity and efficiency that it will be necessary only to occasionally have a few cells of battery at one's house in order to supply an unlimited amount of light or power, that locomotives will be able to run hundreds of miles with a few hundred cells, and that ships will cross the Atlantic, we turn to the gloomiest forebodings of the pessimist, who can reason only from the failures and difficulties of the past to further trials and tribulations in the future. Inasmuch as storage batteries are likely to play a not unimportant part in the future development of electrical science, a proper understanding of the general principles underlying the subject may perhaps remove many popular errors and misconceptions.

A storage battery, or electric accumulator, is an apparatus for the transformation of energy. There is no such thing as storing electricity, and the current of electricity obtained from a storage battery after charging is derived solely from the chemical reactions taking place within the battery. This being the case, therefore, there is nothing mysterious about the operation of a battery, and it is self-evident that the limitations of its power must be directly proportional to the amount of material entering into its composition, which is subject to chemical changes within the battery itself, although from the extravagant claims that are sometimes made for different forms of battery, it might be supposed that the designer had discovered some method for creating energy out of nothing. Fortunately, we are able to measure to a nicety the exact amount of energy to be derived from a given combination of substances, and

FIG. 7. DISTRIBUTION OF LIGHT, HEAT AND POWER AT THE KALAMAZOO INSANE ASYLUM.—WATER TOWER.

such claims, therefore, deceive only the credulous and unwary speculator. There are an infinite variety of forms of storage battery, all of which resolve themselves into two general types, in the first of which, known as the Planté type, the active material is produced by the disintegrating action of the current on a portion of the plates themselves, and in the second the active material is applied directly to or combined with the conducting supports.

A number of different materials have been used in the composition of the plates, but the modern storage battery —the one which is in most general use—consists almost entirely of lead and lead oxides, and the plates composing it are grids, in and upon which the oxides of lead have been mechanically applied.

The modern storage battery is the joint but independent invention of Charles F. Brush and Camille A. Faure, although Brush has been awarded the priority of invention in the United States by the highest court of appeal. Prior to their inventions, in 1859, Gaston Planté made a very interesting and exhaustive study in what might be called the parent form of storage battery, although the real germ of the invention must be awarded to a French chemist named Gautherot, who, as far back as 1804, discovered the reversed currents obtained from plates which had been previously electrically acted upon. It was not, however, until the time of Planté that any attempt was made to store the electrical energy from an outside source by means of a battery or accumulator.

The original Planté battery consisted of plates of lead which were repeatedly and alternately acted upon by a current of electricity, first in one direction and then in the opposite one, until a certain proportion of the lead had been converted into oxide of lead and spongy lead. When two lead plates are placed in dilute sulphuric acid and their terminals are connected with the opposite poles of a dynamo, or some other source of electricity, and an electric circuit is made, oxygen is generated, through electrolysis, on the plate connected with the positive pole, and hydrogen on the plate connected with the negative pole. The oxygen attacks the plate of lead and combines with it, forming a thin coating of peroxide of lead, the hydrogen on the first charge escaping as hydrogen gas.

The plate connected with the positive pole is called the positive plate, and that with the negative pole the negative

1. From *Cassier's Magazine* for December 1894.

plate. If now the current is reversed and the positive pole is attached to the former negative plate, this, in turn, becomes coated with a thin coating of peroxide of lead, but the hydrogen which is liberated now at what was the former positive pole, instead of merely passing off into the air, acts upon the thin coating of peroxide formed by the original charge, and reduces it to spongy lead. The current is again reversed; the spongy lead produced by the second charge is peroxidized, and a further oxidation of the lead plate

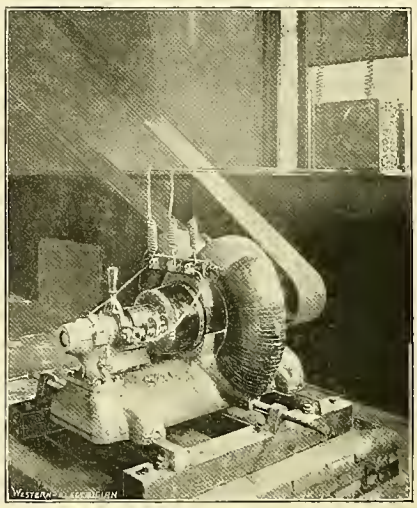

FIG. 8. DISTRIBUTION OF LIGHT, HEAT AND POWER AT THE KALAMAZOO INSANE ASYLUM.—LAUNDRY MOTOR.

takes place. This operation is continued for a great number of times until the coatings thus formed are sufficiently large to do a useful amount of work, and the battery is then said to be "fully formed." In order to overcome this tedious operation of formation, it occurred to both Brush and Faure that inasmuch as the peroxide of lead and spongy lead were the useful parts of a battery, that if they could be applied directly to the lead plate, the plate acting in this case merely as a conductor, all the useful effect of a storage battery could be obtained at once without the necessity of the tedious process of formation, and this was the real invention in the Brush-Faure type of battery.

Brush took the oxides of lead and rammed them into grooves which had previously been made in the lead plate, while Faure took the same oxides and, mixing them with a little dilute sulphuric acid, plastered them first on the surface of a plain sheet of lead, and afterward into various forms of lead supports in the shape of grids or plates provided with other receptacles which would retain the active material. The oxides were then in some cases reduced to spongy lead by chemical means, or the plates put directly into circuit with the dynamo, and the oxides converted into peroxide of lead and spongy lead, after which they were ready to generate a current of electricity on having their terminals connected.

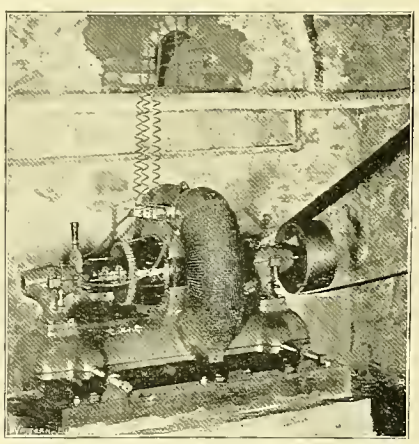

FIG. 9. DISTRIBUTION OF LIGHT, HEAT AND POWER AT THE KALAMAZOO INSANE ASYLUM.—MOTOR IN CARPENTER SHOP.

As has been said above, the current derived from a storage battery is produced by purely chemical means. If a piece of zinc be placed into dilute sulphuric or hydrochloric acid, a violent action immediately takes place with the evolution of hydrogen gas, and the generation of a definite amount of heat. If, however, we connect this piece of zinc with a copper wire, the end of which is also placed into the acid, the wire becomes endowed with the extraordinary properties which are produced by what we call an electric current, and as this phenomenon appears, the generation of heat in the acid disappears. It has been found, after the most careful investigations and research, that the electrical energy measured in footpounds, derived from the consumption of a pound of zinc in a battery, is exactly the same as the amount of energy in the form of heat, measured in footpounds, that is produced by the burning or combustion of a pound of zinc, showing conclusively the correlation of these two physical forces.

The electrical energy derived from a storage battery is, therefore, due to the electrical burning or combustion of the

lead, of which its active part is composed. In the case of a lead storage battery the product of combustion, sulphate of lead, is not soluble in the acid or what is technically termed the electrolyte. One pound of lead has a theoretical potential energy of about 0.15 of a horse power. But in order to utilize in a battery a pound of lead, which must be in a spongy condition, five pounds of solid lead and oxide of lead are necessary, and even then only one-half of its potential energy can be taken out as useful work before it becomes necessary to recharge the battery. Of course, the remaining 50 per cent. is not lost, but it is retained as a surplus, like the water in a tank which is allowed to discharge one-half its contents and is then filled up again.

If then we know the amount, by weight, of spongy lead and peroxide of lead, or that of any other equivalent active material, we have an absolute means of measuring the maximum capacity of any given cell for furnishing electric energy for a given time, and thereby determining the limitations of its usefulness. The source of the electromotive force of a battery, whether primary or secondary, is primarily dependent on the relative positions that any two elements or substances occupy in the electrical scale. By the electrical scale is meant the systematic arrangement of all elements and compounds beginning with the most electro-positive substance, and passing to the most electro-negative substance, in the order of their degree of intensity with which they possess one or the other of these properties. Each substance in the scale is electro-positive to the substance immediately below it, and electro-negative to the substance immediately above it; the substances at the begioning and end of the scale exhibiting, of course, electro-positive and electro-negative qualities in the highest degree.

The metals, as a rule, make electro-positive elements, and the non-metals, oxides and chlorides, etc., make electro-negative elements. Or, in other words, the various chemical affinities which these substance have for each other determine the electromotive force of the couple. This varies from the smallest fraction of a volt to about 3 volts, and in ordinary secondary batteries averages about 2 volts. In order to get any desired electromotive force above 2 volts from a battery, it is necessary to couple the elements in what is commonly termed "series," that is, to have a number of them whose poles are connected to each other alternately negative and positive, which makes the electromotive force cumulative, similar to the winding of an armature, whereby the electromotive force is increased in proportion to the number of turns of wire passing through a given field of force.

One of the most important applications for storage batteries is found in connection with electric lighting. Electric lighting with such batteries may be divided into isolated lighting and central station lighting. All isolated installations that are now being run night and day can advantageously and economically be improved by the addition of a storage battery, and the continuous operation of a dynamo thus be dispensed with, as well as the services of an extra engineer. When plants are not run night and day, owing to the great expense which it is impossible to avoid in operating a few lamps before and after the hours of maximum load, it is necessary to use gas or other source of illumination. This is a ridiculous and unnecessary humiliation to the owners of a costly installation, when a few storage batteries only are required in addition to the plant which they already possess to make it available day or night.

When lamps are supplied direct, the machinery must have a power capacity equal to the maximum number of lamps, and since the lamps are usually needed only a few hours a day, the plant will remain idle the rest of the time. Moreover, the engine and dynamo must be of the best construction and design, steady and quick regulating, to prevent flickering or variation in candle-power. But with storage batteries the generator is not limited as to the time or manner of working, and can prepare its supply slowly, ahead of time, during the day, in the many hours at its disposal; and in addition to its requiring only a dynamo of very much smaller size, the machinery may be of much simpler and cheaper construction, for with the battery, irregularities in movement can exist without in any way affecting the quality of the light. The current from the accumulators is always uniform and regular, even while the charging current is subject to marked fluctuations. The storage battery is, in fact, an equalizer and regulator to the dynamo, besides acting as a reservoir in case of accident, liable to happen with the best machinery.

In all cases a direct lighting plant can be made complete and perfectly reliable by the addition of storage batteries, as the surplus energy, which can be stored while the dynamo is running under light load, can be utilized during the remaining hours of the day or night. With water or gas, we cannot expect a reliable supply without providing facilities for storage. In the profitable and practical application of electricity, we must also have a means of storing to insure an absolutely steady and uniform current, so necessary with incandescent lighting, and also to provide against any possibility of the extinguishing of the lights by failure of the generating plant.

The problem of domestic lighting has been solved by the introduction of storage batteries. Heretofore, electric light was only obtainable in localities adjacent to a central station, but by the application of accumulators almost any power can be made available. In places where an arc circuit is already installed, the introduction of the incandescent light becomes a comparatively simple and inexpensive matter. The arc dynamos can be used in the daytime to charge the batteries, and at night to supply the arc lamps, while the stored electrical energy is used to supply the incandescent lamps.

As an accessory to direct lighting in mills, or other manufacturing establishments, hotels, office buildings, schools, institutions and public buildings, the advantages of the use of storage batteries are too apparent to admit of argument. They furnish light when the power is shut down (which is usually at six o'clock), for office work, watchmen, storerooms and warehouses, for repairing and rearranging machinery, boilers, engines, shafting, etc., which in many cases has to be done at night. They will also furnish power for running electric motors, when other sources of power are stopped, as at night, or on Sundays or holidays.

The advantages to be derived from the use of storage batteries in an isolated electric light installation when once fully recognized and appreciated by electrical engineers will render their introduction well-nigh universal. They may be summed up as follows: Light and power on tap at all hours of the day or night; the ability to add incandescent lighting to an arc system already installed; increase in life of lamps due to perfect regulation of the current, thus effecting a great saving in lamp renewals; as an auxiliary to direct incandescent lighting, where it is not possible or practical to keep the generating machinery in continuous operation; ease of manipulation and freedom from annoying breakdowns and other mechanical irregularities; the battery may be charged from either arc or incandescent circuits by the introduction of proper automatic safety switches and rheostats; the utilization of the current for many household conveniences, such as the running of fans, sewing machines, clocks, electric bells, pumps, etc.; economy obtained by dispensing with an extra engineer for night work, and by obviating the necessity of running a large engine and dynamo for lighting a few lamps during the day or night, or before and after the time of maximum load.

The ideal electric lighting for country homes is to be able at all hours, night or day, to turn on one or the full quota of lamps, with a never-failing supply of electricity, without the annoyance and expense of running the generating plant all night. This can be obtained only by the use of storage batteries, in which sufficient energy is stored during the day, according to the amount required for the twenty-four hours. Where steam power is not available or is otherwise objectionable for charging batteries, a reliable, safe and economical power is a good oil engine, which is so simple to manipulate that an ordinary workman or gardener may be educated in a few days to safely operate and attend it.

One important point to be remembered is that with a storage battery the generating machinery need be only a fraction of the size required for direct lighting. Inasmuch as the work done in an isolated plant does not average more than three hours per lamp per day or, say, for a 100 light plant, three hundred lamp hours, it is manifest that a 50 light dynamo running six hours will accomplish the same work through a storage battery as a 100 light dynamo running direct.

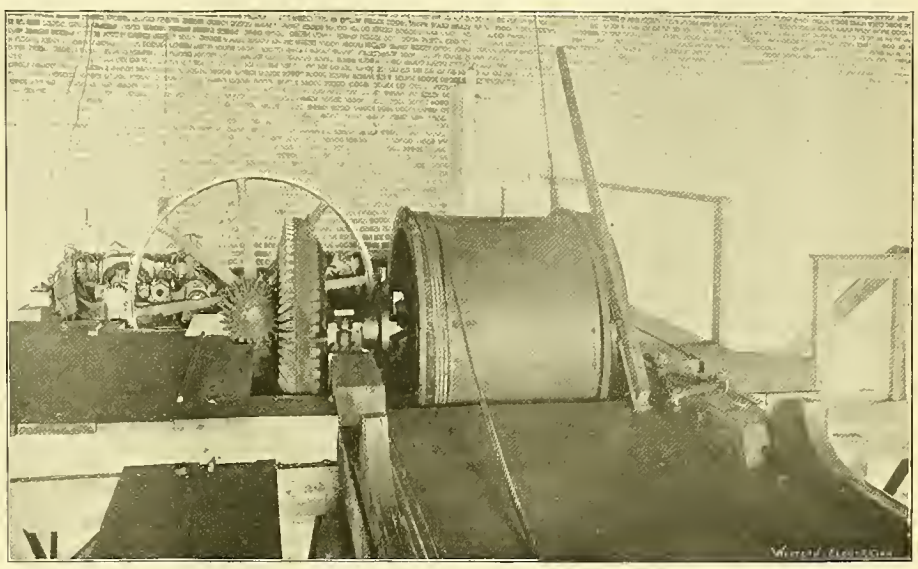

FIG. 10. DISTRIBUTION OF LIGHT, HEAT AND POWER AT THE KALAMAZOO INSANE ASYLUM.—ELECTRIC COAL HOIST.

The advantages of using storage batteries in central station lighting may be briefly summed up as follows: They effect a substantial saving in operating expenses; they increase the factor of safety; they permit of a material extension of distribution without increasing the size of the power plant. Since the question of economy is largely the determining factor in considering the advisability of introducing a battery, let us examine more at length the means by which economy may be effected:

1. By taking care of sudden and excessive load when all the generating machinery is taxed to its utmost extent.

2. By dispensing with one shift of labor in taking care of the entire minimum load.

3. By permitting the operation of large units exclusively.

4. By operating all the units at their maximum load, and hence their maximum efficiency.

Owing to the peculiar nature of electric lighting it frequently happens that the number of units generated at the maximum load is not more than a few per cent. of that of the total average load, and the total load is only a few per cent. in summer, and rarely above 40 per cent. in winter, of the total possible output of the plant.

The first requisite in determining whether a battery can be advantageously introduced in any given central station, and if so what its size or capacity shall be, is to have diagrams of the load curves. The next important factor is the number and size of the units employed at the station. From these data can be determined what has very appropriately been called the load factor, and then it is simple to calculate the size of the battery required to give the most economical operating results. Once the size of the battery determined we can calculate the saving effected:

(a) By dispensing with a night shift.

(b) By diminishing the consumption of coal for a given output.

(c) By the saving effected by operating a few large units of one size, instead of a number of small units of various sizes.

(d) By the saving effected in operating each unit at its maximum efficiency.

(e) By the additional revenues from increase of total output taken from battery at time of maximum load.

As the item of labor in small stations is frequently as high as 25 per cent. of the operating expenses, the saving effected by dispensing with a night shift is not inconsiderable. By operating exclusively large units, there is also a material saving both in labor and the much higher efficiencies of large over small units. Again, as the coal bill is the largest item of expense, amounting in some cases to 50 per cent. and over of the total operating expenses, any saving effected in this item is of paramount importance and is reflected at once in the decrease in operating expenses.

The question of mechanical efficiency with varying loads has not been as carefully studied with each type of engine as its importance deserves, but Prof. W. Cawthorne Unwin has shown that the decrease of mechanical efficiency for light loads has a serious effect on the economy of working with a variable load, and that with a load varying from 100 to 25 per cent., the efficiency decreases from 85 to 40 per cent. While it is impossible to say in a general way what the exact saving would be from the introduction of a battery of sufficient size to permit of the operation of all the units at maximum load (since the load is not the same in any two central stations), the results prove that in central stations equipped with storage batteries the operating expenses are diminished as much as 30 per cent.

As to the factor of safety, in case there is a derangement or break-down of the generating machinery, or where the steam pressure cannot be kept up to a sufficiently high point to operate all the units at maximum load, the elasticity of a storage battery permits of an immediate discharge rate enormously in excess of its normal rate. In other words, a battery designed for a given output could, in emergencies, be safely called upon, for one-half hour or more, to deliver a current three times as great as that for which it was designed.

This is a question of vital importance, as in any direct system of transmission there is always the liability of a derangement or break-down of one of the links in the chain, whereas in a station equipped with a storage battery the manager can depend on the battery to take the load of an individual unit until such time as the derangement or break-down can be remedied or repaired. Moreover, it frequently happens where the business of a station has increased since the original introduction of its generating machinery, that the boiler capacity at maximum load is so taxed that it is difficult to maintain steam pressure sufficient to operate all the units at once. In such a case, if a battery is employed, recourse may be had to the battery until such time as the engineer shall be able to keep steam up to the required pressure.

As regards distribution, it is evident that when a central station, for example, has supplied the demand within a given radius of economical distribution, and a demand arises for electric light or power immediately adjacent to and outside of this given radius of distribution, it is possible to supply this demand by having sub-stations of storage batteries which may be charged by a special wire at comparatively high pressure during the day, thus increasing the average load of the central station. At night the current may be distributed from the sub-stations at the regular pressure, thus enabling the central station to materially increase its revenues without increasing its original power plant. There is an economy also effected in this method of distribution by decreasing the size of the feeders to the outlying districts. This is accomplished by being able to charge the batteries used at a comparatively small rate for 10 or 12 hours, whereas by lighting direct, the feeders would have to be large enough to carry the entire load of the sub-station at its maximum output, which might last only for two or three hours.

Besides the saving effected in operating expenses, the use of a battery may be made to yield additional revenues in proportion to the amount of current supplied to the circuit over and above what could be supplied by the direct system at the time of maximum load, without increasing the size of the power plant.

From what has been said above, it is evident that central station lighting is one of the most important fields of usefulness of the storage battery, and one which has hardly yet been touched upon.

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THE state of Michigan may well take pride in the central plant for lighting, heating and power transmission at the Kalamazoo Insane Asylum, which is described in this issue. It is one of the best and most complete equipments of its kind in the West, as it well might be, having been designed in accordance with the advice of the engineering faculty of the University of Michigan. There is little doubt that in time all public institutions with segregated buildings requiring light and power will be similarly equipped.

THE annual meeting of the stockholders of the Philadelphia Traction company was, according to the reports received, a very interesting and happy gathering. The reports for the last year showed a gratifying increase in the business of the company, and the officers announce that the prospect for greater increase with the extension of the trolley lines is exceptionally bright. The record of this company proves conclusively that a trolley system properly installed and judiciously managed is an excellent investment. The experience of companies like that at Philadelphia will do much to restore confidence among investors.

"KILLED by a Cable Car" has been substituted in several New York dailies as a regular scare head in place of "The Deadly Trolley." Chicago has grown accustomed to cable car accidents, but is horrified at the mention of the trolley. The residents on a South Side thoroughfare, upon which is operated a horse car line, are making a vigorous fight against the proposed introduction of the trolley. Generally speaking, Chicago may be depended upon to be among the first to take advantage of all improvements in public service. In common with the rest of the world, she has been somewhat bewildered and misled by the cry against the trolley, but now that several lines are in daily operation it is safe to assume that the day is at hand when opposition to this system will be withdrawn.

THE full text of Judge Seaman's opinion in the electric welding litigation recently decided in the United States Circuit Court for the Eastern District of Wisconsin is presented elsewhere in this issue. It is clearly an important victory for Prof. Thomson; the validity of his patents is sustained, and his valuable work in this field is recognized and admitted. The fact that the defense was ably conducted adds to the value of the decision as an important victory for Prof. Thomson. Judge Seaman in his opinion says that "great research and ingenuity appear in this defense," but the arguments presented did not establish in the court's estimation the contention of the defendant that the process was not invented by Prof. Thomson. On the other hand the court was convinced that "he found a method for employing the electric current, localizing the heat at the joint to be welded and applying simultaneously the requisite pressure so that the separate pieces of metal could be properly united," and this constituted the invention.

THE courts of Texas have distinguished themselves by introducing the doctrine of liability for mental sufferings, particularly in telegraph cases. Now the telephone companies are likely to have to come in for their share of trouble with this class of cases in that state and in others which have adopted its principles. In a recent case, a judgment of $600 was recovered for the failure of a telephone company to transmit and deliver a message summoning the sender's mother to come to the former's assistance at the time of the last illness and burial of her child. The Court of Civil Appeals of Texas not only affirms this judgment but holds that even though the telephone company's agent had no authority to receive a written message and contract to transmit and deliver it, yet it would be bound by his action, if, in the exercise of due diligence to ascertain his powers, considering the character of the services he was performing and offered to perform, the customary and usual practice of the telephone company's office and station agents in conducting business with the public, and all the other facts and circumstances in evidence throwing light upon the subject, the person sending the message might have believed that the agent had such authority.

DIRECTORS of steam railroads are endeavoring to beguile the public into the belief that they are guarding their interests in opposing the extension of electric lines. A recent statement issued by an eastern company says: "The creation of level crossings of steam railroads by electric roads, whether by legislative or judicial permission, must lead to dreadful accidents. The people are calling for large expenditures by the steam railroads for the elimination of all grade crossings, and simultaneously their agents are increasing the danger to those which exist by allowing the electric roads to use them. Public sentiment, sooner or later, will condemn such inconsistency." One need not look far for an explanation of this singular interest in the safety of the public. It is not the danger due to grade crossing, but rather the danger of decreased revenues due to the competition of electric lines that arouses the opposition of the steam companies. Speaking of this subject, the New York, New Haven & Hartford company has issued a statement that it will be compelled to lessen local service in a corresponding degree wherever the electric roads seriously reduce the revenues of its lines. This is the true explanation of the attitude of the steam railroad companies toward the electric companies, and "public sentiment," it is pretty safe to say, will be found to be favorable to the establishment of electric lines.

AMONG the recommendations contained in the annual report of Postmaster-general Bissell none is of greater importance than that touching the subject of the government acquiring control of the telegraph. Mr. Bissell says: "Avoid expensive experiments, like the postal telegraph, rural free delivery, etc." This policy is in direct opposition to that advocated by Mr. Wanamaker, who did everything in his power to promote the governmental postal telegraph project. It is Mr. Bissell's conclusion that as a business proposition the government cannot afford at this time to establish a postal telegraph system. "I believe it would be very unprofitable in itself," he says, "and that it would tend to retard the development of our existing postal system." It was mainly upon the ground of "good business policy" that Mr. Wanamaker advocated the adoption of the postal telegraph scheme. Mr. Bissell disagrees with his predecessor, and he thinks it wholly impracticable at this time. He contends that our existing postal service should be fully developed before adopting postal telegraphy, which would add enormously to the already large deficit of the postoffice department. To undertake such a service simply through the instrumentality of the present organization, he argues, would have a tendency at once to cripple the existing postal service, because its present organization is without a reserve, and this would result, in all likelihood, in an imperfect postal telegraph, which would not be satisfactory to the public even at reduced rates. Mr. Bissell shows that the postal telegraph of Great Britain is operated at a loss. In view of this fact, he asks: "If the establishment of a telegraph plant in a compact country like Great Britain would cost over $52,000,000, what would be the cost of establishing a plant for this country?" With England's annual loss in operation, $800,000, Mr. Bissell thinks it would be many millions of dollars in a country the size of ours, with an unequal distribution of population. This is certainly a set-back for the friends of the postal telegraph, but it was to have been expected. The conservative business sentiment of the country is opposed to such schemes as that under consideration. Mr. Bissell has done the country a real service in thus publicly and emphatically disapproving the project.

IN his late collection of short stories bearing the title "Round the Red Lamp" Dr. Conan Doyle dabbles a bit in electrical fiction, with not very happy results. This particular story is entitled "The Los Amigos Fiasco," and relates to the case of Duncan Warner, who was to have been electrically executed, but in order to make death positively certain those in charge of the affair used such an excessive current that the prisoner's vitality was increased to the extent that it became impossible to kill him by any means. This failure is the fiasco that gives name to the narrative.

Los Amigos is located in the western portion of the United States, presumably in the Southwest, from the Spanish name. It contains what Dr. Doyle calls a "great electrical generating gear," or central station, claimed to be the largest on earth. What use the inhabitants of that sparsely settled region make of such a great current supply is not stated. The company owning this equipment is styled the Los Amigos Electrical Supply company, limited. If there were a real Los Amigos the company would probably bear the title of Los Amigos Electric Light & Power company. The use of the word "supply" in the name of a company distributing current shows that the author has not conformed his British ideas to American conditions. In electrical parlance a "supply company" is one thing in England and quite another in the United States.

The story is confusing throughout. The town must be in a primitive state, because the details of the coming execution are discussed at a "committee meeting" of experts appointed by the town council, and yet it is of sufficient importance to be the residence of Joseph McConnor, "the very man who had designed the dynamos" said to be the greatest on earth. Such a man would hardly be found in a frontier territory, and yet it is to be assumed that Los Amigos is in a territory, because the execution is under the direction of a United States marshal and not the sheriff of a state court or the warden of a state prison. As a matter of fact, the criminal was led to die in "a small brick chamber forming an outhouse to the central electrical station," which "had been used as a laundry." The connection of a laundry and an electric power house is rather vague; but let us pass to the electrical preparation for the execution. The death chamber had "a single chair for the condemned man. A metal plate for his feet was placed in front of it, to which ran a thick, insulated wire. Above, another wire depended from the ceiling, which could be connected with a small metallic rod projecting from a cap which was to be placed upon his head. When this connection was established Duncan Warner's hour was come." We gather that a potential of about 12,000 volts was used, because it had been decided that "the charge should be six times greater" than in New York. But as to such details as current strength or the use of direct or alternating current, Dr. Doyle is provokingly silent. He does make Peter or Philip Stulpnagel (both names are used for the same person) declare "that workmen who have touched the wires, and who have received shocks of only a few hundred volts have died instantly." This is misleading and should not be permitted in what appears to be the "true" part of the story.

Of course it is clearly within the story teller's province to be as fantastic as he pleases in bringing about his situations; but the skill of the writer is very largely shown by the correctness and life-like color of the everyday surroundings of his figures. With the absurdity of the climax in "The Los Amigos Fiasco," then, we have nothing to do; but we are certainly disappointed and repelled by the inaccuracy and lack of art shown in handling the details of this electrical story.

## New York Electrical Society.

The New York Electrical society has prepared an excellent programme for its winter meetings, the special features of which are outlined in the circular issued by the secretary, George. H. Guy. This society, which claims the distinction of being the oldest electrical body in the country, was formed in 1881 "for the advancement of electrical knowledge and study of electrical and other scientific phenomena." That this purpose has been effectively carried out is shown by the fact that the society's list of members now numbers 350. and is rapidly increasing. It has been found advisable to extend the scope of the society by supplementing the regular course of lectures and papers with a series of "visiting meetings," at which the members are enabled to see practical illustrations of work in the leading branches of electrical application. These meetings have been highly successful, and will in future form a regular feature of the season's arrangements.

At the last meeting the members listened to a lecture on "Direct Current Motor and Dynamo Designing" by Gano S. Dunn. Among other points in this lecture special reference was made to rating and its effect on design, the later forms of windings (such as two-circuit, double, etc.), sparking and armature reaction, and a method of making the increase of potential in a compound-wound generator proportional to its load.

Other lectures arranged for during the season are the following: "some Leading Phenomena and Principles of the Alternating Current," by C. S. Bradley; "The Production of the Higher Forms of Carbon (Such as Carborundum, Diamonds, etc.). by Electricity," by E. G. Acheson; "Niagara on Tap: A Lecture on the Details of the Water Power of Niagara," by T. C. Martin (the lecture will be illustrated by lantern slides made from photographs taken specially for the lecture); "The Doctrine of Unity in Electricity," by Dr. Michael I. Pupin: "Street Railway Practice in the United States," by C. B. Fairchild (the lecture will be based on personal observation in a trip across the country and through the South, and profusely illustrated by lantern slides); "Use of the Electric Light in Lantern Projections," by E. L. Hopkins (in this lecture the incandescent light and the arc light will be shown on the screen under varying conditions, and the voltmeter and the ammeter will also be visible, so that their readings can be followed with all the changes in the power of the light); "The Static Machine and its Use and Office in Electrotherapy," by Dr. W. J. Morton. It is proposed to visit several central stations, both for lighting and power, in and about New York during the winter.

## Singular Experience at Southampton.

S. W. Durkin of Southampton read a paper recently before an English society in which he related the following experience of the Southampton Electric Light & Power company:

The electric company has now been supplying current for several years from a low-tension plant, and it appears to be a very good example of central station lighting. Up till October 16th last the two underground systems for supplying each kind of artificial light had gone on without molesting each other or disturbing person or property. On the evening of October 15th, however, there was, it seems, a leakage on one section of the electric mains. On the following morning the electric light inspector went into the High street to localize it. After opening up one or two covers, the man detected gas, and soon after telephoned to the gasworks for our inspector to come to his assistance. The latter, on arriving on the scene of action, had the whole of the traps over the section opened up, and as they went down the street gas was scented more and more strongly, until they came very near to what proved to be the source of the mischief. I was sent for, and the question was what to do in the emergency to prevent any mishap and to stop the gas leakage. The gas-main was under the curb, so that the service pipes were short in length. These latter I determined to strip and examine. Another precaution was to isolate the main; but, fortunately, this became unnecessary, as the second service we opened, and which passed under the floor of the culvert, revealed the cause of the mischief. The electric mains, as previously stated, are laid for the low-tension system, and are strained up to bridges placed at intervals across the culvert. These mains are formed of copper bars about 1 inch by ¼ inch in section. The gas service was supposed to be insulated by a stoneware tile, semi-circular in section, embedded in Portland cement rendering on each side, but the center was above the culvert floor. This insulation might have continued had the copper main kept its original position, but from some cause it sagged (perhaps from a holdfast breaking) and rested on the insulating tile. Then the electric current, anxious to leave its copper-bound lodging, made a crater-shaped hole through the tile. The opening is about 0.75 inch in area, and of irregular form. The copper main was fused and fell asunder, dropping far enough away to prevent further short-circuiting. There was evidence of the gas having been lighted, there being a deposit of carbon found on the stone cover of the culvert. But for some reason the flame went out; the presumption is that it was for want of air to support combustion. It was very satisfactory that no explosion had occurred. At the same time this incident shows the culvert system to be one likely to lead to disaster when in close proximity to gas-mains in public thoroughfares. In this instance there were 360 yards of culvert charged with gas. The damage was soon made good by those concerned, and a new form of insulator inserted. which, I trust, will prove more reliable than its predecessor.

## The Law of Invention.[1]

By Horace Pettit.

Where a mere doubt exists at the time of application regarding the novelty and patentability of an invention, it is generally resolved, as it should be, in favor of the applicant, and the courts, when subsequently called upon to pass upon such patent, will, as they should, be considerably guided, where such a doubt as to patentability still exists, by the fact that the invention in question has proved commercially successful.

As a usual rule, however, in the class of cases just referred to, it will be found that where an invention has proved successful commercially, there is some inherent reason for it residing in the invention itself. This may be illustrated, for instance, by the celebrated telephone cases, where a mass of alleged anticipatory testimony, some of it very strong, was produced. It is true that the credibility of some of the testimony was very much doubted by the court, but Mr. Bell had in his favor throughout the whole proceedings the fact that he had described a successful operative means of transferring to, or impressing upon, an undulatory current of electricity, the vibration of air produced by the human voice in articulate speech, in such a way that the speech was carried to and received by a listener at a distance on the line of the current. Never before had such an invention been given to the public; it was one of the greatest inventions of the age, and naturally it would have taken very strong evidence of anticipation to have defeated his patent. (American Bell Telephone cases, 126 U. S., 863).

The Bell company rested its entire case upon the fifth claim of the Bell patent, which is as follows: "The method of, and apparatus for transmitting vocal or other sounds telegraphically, as herein described by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth."

It is interesting to note that when Bell applied for his patent he had never actually transmitted telegraphically-spoken words so that they could be distinctly heard and understood at the receiving end of his line; but, as stated by Mr. Chief Justice Waite, in delivering the opinion of the court, "In his specification he did describe accurately, and with admirable clearness, his process; that is to say, the exact electrical condition that must be created to accomplish his purpose; and he also described with sufficient precision to enable one of ordinary skill in such matters to make it, a form of apparatus which, if used in the way pointed out, would produce the required effect, receive the words, and carry them to and deliver them at the appointed place. The particular instrument which he had and which he used in his experiments did not, under the circumstances in which it was tried, reproduce the words spoken so that they could clearly be understood; but the proof is abundant, and of the most convincing character, that other instruments, carefully constructed and made exactly in accordance with the specification, without any additions whatever, have operated and will operate successfully."

It will thus be seen that although Bell did not give to the public at the date of his application for a patent a commercially operative device, and never up to that time had constructed one himself, he did, nevertheless, describe and claim such a device in his application as would enable others skilled in the art to make a succesful operative commercial device. Perhaps it may safely be said that at the date of Bells's application he had not been as successful in his actual experiments as some of those who had experimented before him, but they had never completed, either in an actual device, or upon paper, the invention to the extent to which Bell had perfected it.

Mr. Chief Justice Waite said *inter alia:* "Some witnesses have testified that they were unable to do it (construct an apparatus from Bell's patent); this shows that they, with the particular apparatus which they had, and the skill they employed in its use, were not successful; not that others, with another apparatus, perhaps more carefully constructed, or more skillfully applied, would necessarily fail. As was said in Webster Loom company vs. Higgins (105 U. S., 580, 586), 'when the question is whether a thing can be done or not, it is always easy to find persons ready to show how not to do;' if one succeeds that is enough, no matter how many others fail. . . . The law does not require that a discoverer or inventor, in order to get a patent for a process, must have succeeded in bringing his art to the highest degree of perfection. It is enough if he describes his method with sufficient clearness and precision to enable those skilled in the matter to understand what the process is, and if he points out some practicable way to put it into operation. This Bell did."

1. Abstract of lecture delivered before the Franklin Institute, Philadelphia.

## Franchise Cannot be Leased.

The Supreme Court of California has decided that a franchise granted by a municipality cannot be transferred or leased to a third party. The point was raised in the case of the Visalia Gas & Electric Light company agains Sims, where it appeared that the company leased an electric light and gas plant for a term of two years. According to the terms of the contract, the lessee was to operate this plant, and pay to the company every three months, during the two years, all the receipts, after paying the necessary charges incurred by carrying on the business. The agreement was further to the effect that the amount so paid should be sufficient to enable the company to pay to its stockholders 5 per cent. upon its capital stock of $28,000, and in case of deficiency he would pay to the company every three months such further sums as would enable it to pay these dividends. The defendant in the action had become a surety of the lessee, and upon the failure of the latter to make the payments as agreed, the surety was called upon to meet the demands. The court holds (37 Pac. Rep., 1042) that since the company had availed itself of the fraochise granted to it by the city, it was its legal duty to operate its own electric and gas works, and to supply the inhabitants with gas and electricity, and that it was not authorized to lease its rights and priviliges, which rendered this contract void and relieved the surety from liability for damages.

## Great Western Company Forced to Suspend Business.

On December 1st the Great Western Manufacturing company filed a confession of judgment for $15,000 in favor of Mrs. Mary J. Lamb in the United States Circuit Court of Chicago. Mrs. Lamb is said to be related by marriage to E. R. and H. K. Gilman, who are the moving spirits in the Great Western company. The heaviest creditor of the company is the First National Bank of Chicago, and on November 30th this bank was given a bill of sale of the Chicago store at 116 Market street, covering all stock and fixtures there. The store is now closed and bears a placard stating that the goods are in the possession of the First National Bank. The debts of the company are about $300,000, and the assets are said to amount to $700,000. The First National Bank is believed to be a creditor to the extent of $115,000, the next largest claim being that of the Electrical Securities company of Boston for $100,000. A large portion of the remaining $85,000 of liabilities is held, it is said, by the Merriams' bank of St. Paul, the claims of many smaller creditors making up the balance.

The company was organized on January 13, 1893, with a capital stock of $1,500,000, of which $200,000 was said to have been paid in cash. It was formed by the consolidation of several existing companies, the most widely known being the old Great Western Electric Supply company. The company secured the plant of the Phœnix Manufacturing company in Duluth and announced that it would cover the entire field of electrical machinery and supplies. It is this plant that is now the most valuable asset of the company. At first the new Great Western company did a good business throughout the West and Northwest, but for several months the fact that the concern was in financial straits has been an open secret in the electrical trade.

The Chicago daily newspapers published this explanation of the misfortunes of the company:

The company has been exceedingly unfortunate in business, apparently through no fault in its management. J. F. Reed, of the law firm of Reed, Brown & Allen, formerly its secretary, said that the Great Western Manufacturing company had been mixed up in almost all of the noteworthy failures which have occurred recently. When the Fond du Lac Electric Street Railway company failed the Great Western was a heavy loser, as it was also through work on the electric railways in Atchison. Here the loss was the result of the insolvency of contractors who sublet certain portions of the work of building and equipping the road to the Great Western Manufacturing company. The company has been busy in spite of the hard times, and would have realized good profits had it not been for the unfortunate circumstances and others similar which attended so many of its deals. Collections from other sources have been exceedingly slow, and for that reason much of what should have been profit has turned out a loss. The company has been obliged to carry several street railways, among them being roads at Fond du Lac, Wis., Atchison, Kas., and Atlanta, Ga.

As the Chicago Insulated Wire company has been mentioned in connection with the affairs of the Great Western company in the daily papers, it should be stated that the two companies are entirely distinct and independent. The plant of the old Chicago Insulated Wire company was purchased from the Great Western Manufacturing company in March, 1893, by the present owners—Edward Carroll of Leavenworth, Kas, and T. C. Turlay and W. M. Smith of Chicago—and it should be understood that the Chicago Insulated Wire company of to-day is entirely independent.

## Combined Gas and Steam Engine Plant.

A unique electric lighting and power plant, which will afford an opportunity to compare the merits of gas and steam engines of the same capacity, working under almost precisely the same conditions, is being installed in Detroit in the newly remodeled Whitney building at Woodward avenue and Clifford street. The tenants wish to avoid excess of heat in summer and therefore contracted with the Otto Gas Engine company for a 30 horse power engine to drive a 15 kilowatt dynamo. The presumption is that the lighting load will be small during the summer and that the gas engine will be sufficient for this duty. During the winter more light will be necessary, and for this purpose a 30 horse power Ideal engine will be used, driving a 20 kilowatt dynamo. Field & Hinchman have been employed to superintend the erection of this plant and to make all necessary tests.

## Philadelphia Traction Company's Report.

An excellent showing is presented in the report of the Philadelphia Traction company for the year ended June 30th, submitted at the annual meeting of the stockholders last week. It showed that the receipts for the year were $5,194,990.52, and the expenditures $4,702,416.70, leaving a net profit of $492,573.82. During the year 136,327,329 passengers, including transfers and free riders, were carried. This is an increase over the previous year of 10,692,794 passengers. Following is an abstract from the statement of the president:

It is perhaps well to state that the bulk of our trolley roads have been started since the period of this report, which ended the 30th of last June. With two roads running during the last six months of the last fiscal year, the report shows an increase in earnings of $100,000 over the previous year. We feel very much flattered by that showing. We are gradually getting rid of our horse stock. We count the maintenance of a horse at the rate of 50 cents a day, and when we have disposed of the 2,000 horses still on hand we will save just $1,000 a day. Since the introduction of the trolleys our increase in revenue has averaged about $50,000 a month, and the figures for the present month of November will show an increase of not less than $75,000 over the corresponding month of a year ago. Next month we look for even a much larger increase in business. I think that the earnings of the road for the existing year will show all, if not more, than we really anticipated when we began the construction of the electric lines. By the next annual meeting of the stockholders we will have all our trolley roads running, and then we will have begun to get the full benefit of the new system and will be able to show just what we can do. In the light of the past, I don't think that there is any property in the country that has a brighter prospect than this property. We feel that it will certainly give to the stockholders all that has been promised by this management.

The stockholders adopted resolutions extending to the president and directors the thanks of the stockholders for the efficient manner in which they had discharged their duties.

President Widener expressed his appreciation of the stockholders' action, and referred to the care and anxiety that attended the introduction of the trolley system. It had involved, he said, a very large expenditure of money on what most people had believed to be an experiment, but which the management of the company had never regarded as experimental from the first. Turning to the later efforts of the management to develop the full paying capacity of the trolley system, Mr. Widener spoke of the poor business of the railway companies in Philadelphia on Sundays as compared with other cities of the United States. Particular attention had been paid to the growth of the Sunday travel, and now, with the addition of the Dauphin and York streets line, the operation of the Walnut street bridge route and the future occupation of Girard avenue bridge, which he felt sure the company would get, the company has all its roads centering at the park. With the proposed new road within the park limits in operation, people could be carried to any part of Fairmont Park. By next summer he thought the receipts on Sunday would be as great as on any other day of the year.

William L. Elkins added that the increase in the Sunday business would amount to not less than $350,000 without any additional expenditure. General Rusling said that he and others outside of the city had watched the company's development, first to cable cars and then to the trolleys, and they were all of the opinion that the affairs of the corporation had been handled with great skill and discretion. For that reason he believed that it was only just that the stockholders should record their appreciation of the wisdom and labor exerted by the management in bringing the Philadelphia Traction company up to its present flattering condition.

## Electric Haulage in a Michigan Mine.

The use of the electric locomotive in mine haulage work becomes daily more widespread as the advantages inseparable from the adoption of electricity in mines become better recognized. In coal and iron mines electric transmission is steadily supplanting the rope systems and mule haulage, and the time seems rapidly approaching when mines having a large output will generally adopt electric power for this purpose.

About two years ago the Pittsburg & Lake Angeline Iron Mining company determined to install an electric plant, after having become convinced of the economy of the step. At the surface a power house was constructed, and a 14 by 30 inch Reynolds-Corliss engine erected to drive a D 62 500 volt General Electric bipolar generator. Armored mains are taken down the mine on porcelain insulators, and connected in the usual manner to the trolley wire and track.

ELECTRIC HAULAGE IN A MICHIGAN MINE.

The haulage plant proper consists of two General Electric 30 inch gauge locomotives, each equipped with two motors. The locomotives are capable of exerting a drawbar pull of 1,500 pounds each at a speed of from six to eight miles an hour. The motors are of the iron-clad waterproof type.

The length of haul is somewhat short for locomotives, but is too long for profitable tramming by men, the distance averaging from 250 to 1,400 feet. The grade is 8 inches in 100 feet, in favor of the loaded cars, and the curves are sharp, varying from 12 feet radius up on account of the narrow veins. No serious delay has occurred since the plant began operation.

The cost of hauling at the present rate of working, which is not up to the capacity of the locomotives, is two cents per ton, including oil, waste and repairs. In a letter from Captain Walters, manager of the mine, referring to this cost, he says: "This is per ton on the ore hoisted. Extra to this, we close-timber all of our ground. The timber is hauled around and left with each party of contractors in turn. I should say here that I have put in no percentage for the first cost or outlay. If I had to do this work by hand, as we used to do, I would have been delighted to let a contract in the mine to have the ore trammed and timber delivered at places needed, at eight cents per ton for ore hoisted."

The Bluff City Electric Railway company of Waukesha, Wis., has completed its organization with Homer Cooke, president; T. H. Lindsay, treasurer; S. D. Talcott, secretary; H. Cooke, G. R. Lyon, S. D. Talcott, N. A. Steele, J. F. Powell, W. H. Dodge and T. H. Lindsay, directors. The capital stock is $200,000 and a few shares are already subscribed. The company intends to secure the right of way and build the system itself, if possible, or assist any responsible person to build it, that the city may secure the benefits of rapid transit.

## Down-town "L" Loop Projects in Chicago.

Charles T. Yerkes announced by telegraph from New York on Saturday that a definite agreement had been reached among the elevated road interests of Chicago, binding each and all of them to use the loop of the Union Terminal railway. As the principal obstacle in the way of an immediate settlement of the loop problem was the resistance of property owners to the several propositions having in view the erection of single-company loops in the business district, the present outlook is clear, since no opposition appears to the project to put up one central terminal structure for the use of all the elevated railways. It is even said that the property owners are desirous to further the designs of the Union company, and money for the prosecution of the plan is now at command, so there seems to be almost a certainty that in a very few months it will be possible to take an elevated train on the most remote terminal of the West Side and without delays or tedious transfers to proceed to the most distant station on the line of the alley "L" or of the Metropolitan or Northwestern elevated roads when they are in operation.

Congressman McGann's company, the Chicago General, will go to the council soon to ask for an ordinance to an independent company organized to construct a down-town loop for the use of all the companies over streets to be named. The route is expected to be from Wabash avenue to Lake street, thence to Franklin or Market street, south to Harrison street and east to the point of origin. The ordinance is to declare the structure a portion of the public highway and its use subject to future regulations. It will provide that any company so desiring may use the structure on giving proper consideration. A license fee is established to be fixed each year. If any company desires steam power it could use its own engines. If electric power is used, then an independent plant should be installed for the loop and each car using current required to pay an additional price. The Chicago General company will subscribe for its share of the bonds to construct this loop.

## The Trolley in Chicago.

In no part of Chicago has there been such determined opposition to the trolley system as on Indiana avenue, where the Chicago City Railway company proposes to substitute an electric system for the present horse car line. According to the *Chicago Herald* the present condition of the controversy is as follows:

The opponents of the trolley have reproduced a contract entered into in 1876 between the City Railway company and owners of property on Indiana avenue by which the company obligated itself to operate the railway line on that avenue by "animal power" only. Of course this was long before the trolley system was invented, and the contracts were entered into to prevent the establishment of the cable or steam or any other mechanical propelling power for the cars. But the agreement holds as good against the trolley or any other motor as it does against the cable or steam.

There were other considerations named in the agreement of 1876. Previous to that time the company had but a single track on Indiana avenue, with turnouts, where the cars met and passed each other. The company was permitted to lay a double track, for which it agreed to pave and keep in repair certain portions of the street.

It is not easy to see how the street railway company can evade the terms of this contract, which applies to the avenue from Twenty-second street to Thirty-ninth street. The courts would be extremely unlikely to set it aside. The ordinance of the council authorizing the company to use the trolley on the avenue cannot annul the contract. It is of binding force until waived by a majority of the property owners in accordance with its terms.

## Proctor-Raymond Electric Bells.

Improvements in electric bells, both in form and construction, have been made by the Proctor-Raymond Electric company, Rochester, N.Y., which is manufacturing the Eclipse iron-box bell and the Rex, a wood-box bell. Both of these are recognized as standard devices. In Fig. 1 is shown the wood-box bell with the cover removed. This has a cast-iron frame and riveted contact, and it contains several important features for preventing it from getting out of adjustment. A square contact post, a special form of binding post, securely fastened into the wood, and a square head for the gong seat, receiving the square hole provided in the gongs, make it impossible for the contact post or binding post to turn or loosen, or for the gong to work loose, and effectually prevent the bell getting out of adjustment when once properly put up. The new Eclipse iron-box bell, shown in Fig. 2, is very simple, thoroughly constructed and well proportioned in all its parts.

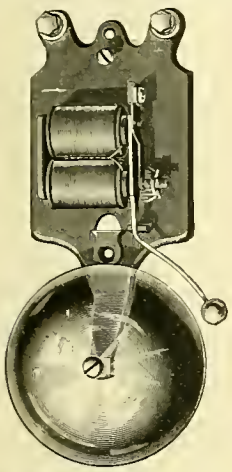


FIG. 2. PROCTOR-RAYMOND ELECTRIC BELLS.

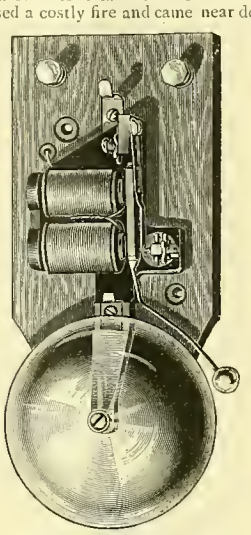
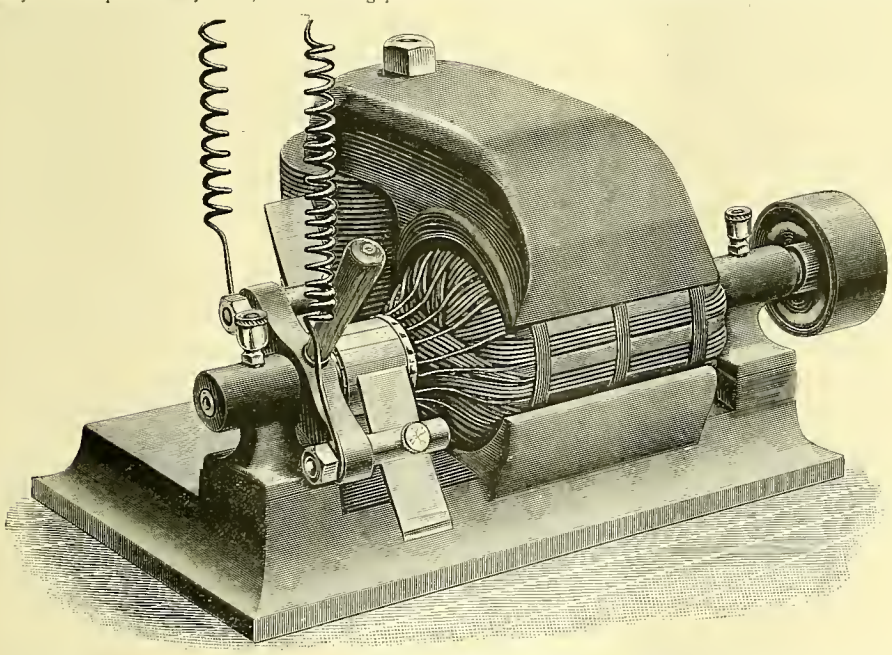


FIG. 1. PROCTOR-RAYMOND ELECTRIC BELLS.

## A New Five-light Dynamo.

The accompanying cut illustrates a new dynamo having a capacity of six amperes at fifty volts, which is being placed on the market by the Elbridge Electrical Manufacturing company of Elbridge, N. Y.



A NEW FIVE-LIGHT DYNAMO.

As will be seen, the machine is of neat and compact design, and embodies several points of excellence not generally found in machines of this class. The magnetic circuit is short, insuring the strongest possible magnetizing power; it is energized by a single coil, which is wound on a thoroughly insulated spool and can be readily exchanged, being furnished for different voltages if desired.

The armature core is built up of thin disks of soft wrought iron and the coils are wound in milled grooves. The core is balanced before winding and again afterward.

The bearings are sleeves of bronze and the standards are turned on their base to a true arc of a circle of the same diameter that the pole pieces and bearing seats are bored on. The pole pieces and bearing seats are bored at one operation. This insures perfect alignment of bearings and armature and a true running shaft.

The commutator is made of tempered copper, is large and has ample contact surface for brushes.

The company is making a specialty of this dynamo, and sells in connection with it a complete outfit of lamps, sockets, wire, etc., in fact everything necessary for a complete plant. This machine has been on the market about one month and is meeting with favor wherever introduced.

## All from a Street Car Stove.

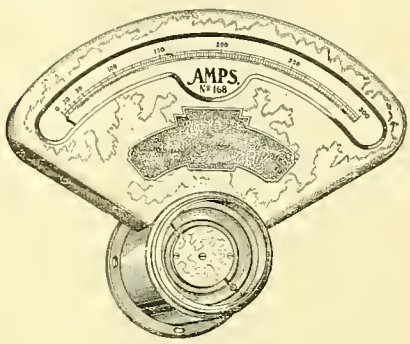
The ordinary street car stove is not a very satisfactory or safe affair at best, but it is seldom that it creates so much disturbance as is related in the following dispatch from St. Louis, dated November 30th:

An explosion of a stove in a street car in East St. Louis at 1 A. M. caused a costly fire and came near destroying several lives. Miss Mamie Sanburn was badly burned about the right arm and shoulders, and she and her sister had to make their escape in their night robes. Their mother, Mrs. Annie Sanburn, was most severely frightened and jumped from a second story window. It was not until the flames had burst into their sleeping apartments that the family were awakened. The residence and furniture were completely destroyed, entailing a loss of $3,000, covered by insurance. A. Roberts and E. Trubold also had a narrow escape from the house facing on Collinsville avenue occupied by them. The roof was ablaze when they were aroused from their slumbers. The explosion of the stove set fire to the car shed of the East St. Louis Electric Railway company, where the car was standing. The shed was almost entirely consumed and seventeen cars were either destroyed or badly damaged. A horse and a mule were burned to a crisp. The total damage done by the fire is $30,000. There is an insurance of $15,000 on the buildings and stock and $31,500 on the cars and rolling stock.

## The Keystone "Type K" Instruments.

The accompanying illustration shows the "Type K" ammeter, made by the Keystone Electrical Instrument company of Philadelphia, for which the George L. Colgate company of New York is sole agent.

These instruments contain no permanent magnets or springs and are therefore not liable to deterioration. All moving parts are mounted in jewel bearings and the case is thoroughly dust-proof. The voltmeters are of high resistance, thus requiring a minimum amount of current and may be left in circuit continuously without affecting the readings. There is also said to be an entire absence of magnetic lag and no heating error. All moving parts are magnetically shielded so that the effect of external magnetism is not appreciable. The scales in the "Type K" instruments are large, with generous divisions, and so arranged that within the limits of the scale readings may be obtained to about one-fifth of the division points marked.




THE KEYSTONE "TYPE K" INSTRUMENTS.

The instruments are very easy to set in position on switchboards, the only requirement being that they shall be plumb. This is easily accomplished by seeing that the needle points to zero when no current is flowing through the instruments. The holes in the flange of the case to receive the screws which fasten the instruments to the board are slotted to allow the adjustment to be made after the instrument has been placed, or to adjust it in case the switchboard should get out of level.

Each instrument, after calibration, is sealed in such a manner that it is impossible to inspect the moving parts without breaking the seal. A calibration card accompanies each instrument shipped, giving the number of instrument, certifying to the correctness of calibration at a given temperature and, in the case of a voltmeter, the resistance of the coil is also stated.

## Theory and Practice in Electrical Engineering.[1]

By Rankin Kennedy.

The nearer theory and practice approach, the better in any science or art. Wherever we find practice widely different from what theory indicates, we may be sure that one or other is somewhere wrong, and it is sometimes profitable and always interesting to compare practice with theory, and thereby ascertain just where we are in these matters.

Hitherto practice has been somewhat unsettled in electrical engineering, but the completion of many public supply stations, and the operation of some of them for a year or two, offers sufficient experience to enable us to compare theory with practice on most important points in electrical engineering.

We will first glance at electrical distribution of energy. The distribution of electrical energy may be carried out by either continuous currents or by alternating currents and either by high pressure and transformers or by low pressure without transformers, on either system.

The simplest system is the low pressure two-wire continuous or alternating current at 110 volts. Theory and practice agree in this case closely; theory proves that an enormous amount of copper is required in the mains to prevent serious loss of pressure and bad regulation, and practice confirms it.

As an improvement on this simple system, theory introduced the three-wire and five-wire systems for the purpose of saving copper in the mains, and thereby also improving the regulation.

Prior to this three-wire system, there was commonly known to practice a three and five-wire system, called the multiple series system, for the same purposes, but the balancing wires were not connected back to the dynamos. Theory pointed out that the balancing wires must go back to the junction of the dynamos, and that then each multiple would be independent of the other multiples, and the theory being very plausible, it was accepted by practice, and in we went for it plump. But practice has shown that the theory does not come out all right. In fact, that there is not much superiority in the three-wire system over the older multiple series system; indeed, the balancing wire going back to the dynamo makes but a small improvement. Yet according to theory this wire should take care of the balancing, whatever the difference between the loads on the two arms of the system. But what does practice disclose? This: that at times of small load, 20, 30 or 50 amperes thrown on one arm of a

1. From the London *Electrical Review.*

three-wire system disturbs the whole so much that regulations are made by the managers forbidding the sudden switching on ot currents of this small magnitude. With such regulations the old multiple series system would work almost as well, and secure every advantage of the three and five-wire systems.

The disturbances on the three-wire system are most at small loads, it is said; but if theory is right, there should be no disturbance at all. The disturbance is also greatest at light loads with multiple series systems, and is very little, if any, at heavy loads in a properly wired system, so that, practically, we find that the three-wire and five-wire systems are not much improvement on the old multiple series systems, for with the same strict precautions as are applied to the three and five-wire systems, a three or five-wire multiple series system would do quite as well. There is, however, no harm in bringing back the balancing wires to the dynamo junctions; they do exercise a little regulation certainly, and every little is worth securing, but they do not effect their purpose completely—that is, to balance the load—for if the load in one circuit suddenly varies, the balance is at once disturbed, and we have fluctuations in pressure ranging from 3 to 10 volts, hence the tender regard for motors and arc lamps on a three-wire system.

Storage batteries may now be compared from the same points of theory and practice.

Theoretically, the storage battery was to act as a sort of fly-wheel and regulate for variations in load. When it is used for this purpose, however, it is found in practice that they do not act as regulators automatically; certainly, if the pressure falls they feed into the mains, and if the pressure rises on the mains they take up energy, but they do not prevent a rise and fall; in fact, they do not act at all if the pressure is steady, but pressure must fall before they feed in, and must rise again before they charge up.

Practically, storage is used at most stations only to meet the small demand for current during the day or small hours in the morning,—a demand which would be better met by a small gas engine or two and a couple of dynamos.

Theoretically, the storage battery was to perform wonders. Practically, it does not answer, for one grand reason, it cannot be charged and he discharging at the same time, like a water, compressed air or gas reservoir; their only value at present is to provide against a breakdown in machinery.

Now, why should there be two kinds of current used, continuous and alternating? Theory answers by stating that if electrical energy is to be transmitted any great distance and in considerable quantity, high pressure must be used; and as alternating currents are easily transformed, alternating currents are therefore adopted. Quite so: here theory is correct and practice agrees in every way; but what do we find in actual practice?

Bearing in mind the sole reason for using alternating currents is the necessity for transmitting large quantities of electrical energy over long distances, so that high pressure may be used and copper saved, that is the theory. What do we find in practice? Corporations and towns laying down high pressure alternating systems where the conditions stated do not exist, where no great quantity of electrical energy is to be transmitted to any distance worth considering, and using 2,000 volts alternating to transmit 50 or so horse power round a corner into the next street. This practice is absurd. The high pressure dynamos, mains and transformers are entirely out of place, and quite superfluous. The small quantity of copper saved in the feeders is far overbalanced by the cost of transformers and other appliances required in connection with high pressure.

In some cases the conditions where high pressure effects a saving do exist, such as where the power house is some miles distant from the centers to be feed and the centers are wide apart, like the Deptford and Niagara schemes; in these cases theory and practice are in perfect accord, but the lighting of the city of London, of Hampstead, Derby, Portsmouth, Scarborough, etc., by alternating currents is bad practice, and contrary to theory, and neither by scientific argument nor by results can the adoption of alternating systems in these and many other places be justified.

Before passing from alternating current systems, let us look at the question of parallel running of the generators, where alternators are necessary. This practice is good, and in perfect accord with theory, provided certain precautions are taken; chief among which is the provision of an automatic instantaneously acting cut-out, placed to cut off any alternator falling out of step or breaking down; with this provided, no falling out of step or accident to one alternator can interfere with the continuance of the lighting. But if separate alternators are used for separate circuits, with no alternators in parallel, as is said to be the case in some places, then, in the event of a breakdown or accident, or the exciting current failing, instant failure of the lighting is inevitable; to abandon parallel running is, both in theory and practice, a mistake; having no storage to fall back upon, parallel running is absolutely necessary. If alternators are run separately, duplicate machines must be provided and kept going, ready to switch in at any moment, but even then there would be an interruption of the lighting.

Thus we see that in some cases theory falls short; in others practice is at fault.

Recently I pointed out the difference between theory and practice in using choking coils; theoretically these coils save energy, but practically the user has to pay all the same for the energy saved, if he is supplied by a public supply through an ordinary meter.

Theoretically the alternating current has advantages for the electrical engineer in transmitting his electrical energy, but practically, to the man who pays for electrical energy, alternating currents have many serious drawbacks, and the practical question is whether the engineer's conveniences or the consumer's needs are to be paramount.

Only for one purpose are both currents equally good, and that is for incandescent lamps. For all other purposes the continuous current is preferable by the consumer, both theoretically and practically.

Theoretically, the current is generated and distributed, to be sold to consumers for application to any purpose; but practically, except for incandescent lighting, it is too costly, hence it is almost exclusively used for incandescent lamps, and the would-be consumer for other purposes is not worth considering.

These few points of agreement and divergencies between theory and practice have struck me as important and well worth attention. They are not pointed out in any fault-finding spirit, but as interesting facts for those looking for guidance in the choice of methods and practice.

Theoretically, alternators have no commutators; but as an exciter is a necessary attendant upon the alternator, practically the commutator is all there, and is of as great importance as ever, for a slight derangement of the exciting circuit will throw most alternators out of step.

Finally, the disadvantages of alternating currents have been practically ten-fold multiplied by the insane practice of adopting various frequencies, instead of fixing upon one common frequency. There is no known theory to account for one place working at 50, another at 100, and another at 133 per second.

## Arc Lamps in Cotton Mills.

The use of arc lamps in cotton mills, upon what is known as the "inverted arc system" of lighting, is slowly but surely making headway in England, according to the London *Electrical Review*. Owing to the murky atmosphere which prevails in English manufacturing districts, where cotton mills most do congregate, and where the sun is rarely seen, there is need for artificial light during greater portion of the working hours, hence the question of lighting is a very important one, not only for mill owners but also for mill hands. Gas at its best is a poor substitute for daylight, and is further objectionable on sanitary grounds. The advent of incandescent electric lighting was a great improvement, no doubt, both as regards safety and health, but it still left much to be desired as a light for mill purposes. Arc lighting, as then known, was found unsuitable on account of the hard shadows cast, and furthermore was regarded as unsafe, and consequently practically prohibited by the fire offices.

The first attempt at mill lighting by arc lamps upon a rational system emanated, if we mistake not, in France. This simply consisted in suspending an inverted cone reflector below the arc, thus throwing the light first upon the whitened ceiling above, and thence upon the work below. By thus doubly reflecting the light, and at the same time shielding the eye from the direct rays, the effect was most pleasing, the perfect diffusion thus attained practically destroying all shadow. The next advance was to invert the arc itself by placing the crater carbon below, and in this form we have what is known as the "inverted arc" system of lighting. So much is the new light appreciated—rivaling daylight itself—that millowners readily pay the extra tax imposed by the fire offices rather than be without it. At the same time it must be admitted that great care is needed when introducing arc lamps in the presence of such highly inflammable material as cotton, and upon this score we venture to offer a few remarks.

There are two cases on record of serious fires in cotton mills traceable to arc lighting. In the first case the usual netted glass globe had alone been relied upon for protection, and owing to some imperfect construction, or, what is more likely, the neglect of the trimmer to replace an injured globe, a particle of heated carbon escaped from the lamp on to the material below, immediately setting fire to the cotton, and resulting in the destruction of the mill. The second case was in connection with the use of an inverted cone reflector suspended below the arc by means of chains, made detachable to admit of trimming. The lamp had just been retrimmed, when the cone reflector was seen to tilt violently on one side, dislodging a large particle of the crater carbon onto the mule beneath, setting fire to the cotton, with the same disastrous result to the mill as in the case above quoted. Here again the trimmer either failed to properly reconnect the chain, or else some part of the suspension gear gave way. Now there is a lesson to be learnt from these two fires. It is evident that glass, or any other such brittle material, should not alone be relied upon as a guard against the escape of heated material from the arc. The necessity for retrimming every six or eight hours during the running of the mill, and frequently under trying circumstances, leads to breakages, which are not always attended to in time; and the bungling or neglect of the trimmer is the one factor most to be feared, as well as the most difficult to provide for. Glass of any kind is therefore better dispensed with. It absorbs much light, particularly when coated with dust, and casts unpleasant shadows. The supposition that there is danger in a naked arc burning in an atmosphere charged with fine cotton flyings, has been proved groundless, and experiments also show that the dust which collects within the reflector is impotent to do harm. In fact, it appears that the one and only danger to be apprehended is the possibility of a considerable particle of the incandescent carbon coming in contact with the material itself. We believe it possible to give all the protection necessary by a well designed and ample metal inverted cone reflector, without the addition of a globe, provided it be permanently and rigidly attached to the body of the lamp. Indeed, it should be a *sine qua non* in all arc lamps for cotton mill lighting that no essential guard or any part of the suspension gear need detaching for purposes of adjusting or renewing carbons.

Next in importance is the suspension gear, for should a lamp fall when in use the result would probably be fatal. Usually the lamp is suspended by a cord or chain, with counterweights, over a couple of small pulley wheels, with considerable wear and tear upon the cord. This, therefore, should be strong, preferably of steel, with well made connections; and as an additional precaution, an independent guard chain is recommended, to prevent the lamp falling beyond a certain distance, in the event of any portion of the suspension gear giving way.

The use of arc lamps in the spinning and carding rooms of cotton and flax mills must always be attended with more or less danger, and only by carefully attending to such details of construction as we have here briefly alluded to can that danger be reduced to a minimum.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, December 1.—At Tuesday's meeting of the Rapid Transit Commission, plans and communications were received from Jesse W. Reno, the proposer of the double-deck four-track road; Herman Rausch, Ogden P. Pell, the secretary of the Central Tunnel company; J. W. Pinchot and Joseph G. William. Upon a motion made by Mr. Low, all such letters will hereafter be referred directly to Engineer Parsons. Mr. Parsons reported that he had studied the plans of the New York Central & Hudson River Railroad company's present and proposed structures on Fourth avenue, and he pointed out that the carrying out of an additional railroad on Fourth avenue conflicts slightly with the company's stations at Fifty-ninth street, Seventy-second street and Eighty-sixth street, and also with its wide tunnel between Eighty-sixth and Ninety-sixth streets. Before detailed plans for the rapid transit structure can be drawn an arrangement will have to be made with the New York Central Railroad company looking to a modification of its structure at these points. A committee consisting of Mr. Orr, Mr. Claflin and Mr. Steinway was appointed to confer with the officers of the New York and Harlem Railroad company and its lessees, with reference to questions which have arisen with regard to rapid transit routes, in so far as they seem to be affected by the railroads of that company.

An unusual form of petty swindling has recently come to light on the East Side. For several weeks residents of that portion of the town, mostly Russian and Polish Jews, have been calling at Ellis Island with bogus dispatches written in blue pencil on the sending blanks of the Western Union and the Postal Telegraph companies. Persons who took the messages to Dr. Senner, commissioner of immigration, said that they had paid from 25 cents to a dollar for the worthless bits of paper, which were handed to them by a boy in the uniform of a district messenger. Most of the messages ran thus: "Please come at once to Ellis Island. I want your assistance." The names signed to the messages would have led any but a foreigner to suspect their genuineness. One message wound up with "Yours truly, Vino Drinkibus," and, it is said, the name on another was "Dink Botts." About fifty persons have been swindled by the uniformed boy and his assistant, if he has one. Commissioner Senner and the telegraph companies are trying to find the boy.

Judge Beach of the Supreme Court has denied the motion of the corporation counsel to quash writs of certiorari obtained by the General Electric Light company, the Edison General Electric company and the Edison Electric Light company for the purpose of reviewing the personal tax assessments imposed for 1894.

Judge Clement, in the City Court, Brooklyn, has decided that, owing to its failure to get the necessary consents of the property owners, the Nassau Electric Railroad company has no right to lay its tracks on Marcy avenue. City Works Commissioner White can now have the tracks removed as a nuisance. The company will appeal from the decision.

The Coney Island & Brooklyn Trolley company has made application for permission to extend its tracks through High street, from Jay to Washington. The property owners have filed a protest against the granting of the privilege. The company is willing to use the underground system, it is said.

Apropos of the sensation growing out of the recent defalcation in the National Shoe and Leather Bank, in which Lawyer Baker and Bookkeeper Seely were implicated, the *Sun* tells a story that has amused the electrical fraternity. "A push-cart belonging to a subway concern halted directly in front of the entrance to Police Headquarters this morning," it says. "Carts of that kind stand there every day, but never one like that. There was an immediate rush for it as soon as some one read the lettering on it and passed the word around. This was it: 'The Complete Electric Construction company, 121 Liberty street; J. Seeley, president; C. Baker, treasurer.' It was a coincidence, of course; that was all. But the names of Seeley and Baker standing together just at this time, and in that place of all places, was too much for the police wags. The word went around that the fugitive bank bookkeeper's belongings had been seized, that Seely's trunk was at the door.

W. F. O.

## St. Louis, Mo.

ST. LOUIS, December 1.—In October the Laclede Gas Light company put a force of laborers at work excavating a trench at the corner of Broadway and Ashley street, preparatory to putting down a conduit for its wires. This procedure was without formal permission from the street commissioner, and the work was stopped at once. Two of the laborers were arrested for violating city ordinances. The gas company claims that under its charter of 1857 it had a right to substitute electricity for gas and was thereby authorized to

lay underground conduits or subways for such purpose. The company has always obtained formal permits for laying gas pipe, and it is not clear how it expected to go into the business of laying electric conduits without similar consent. A few days after this event the company made formal application for permission to open the streets for the purpose of laying electric conduits. With this request was sent a copy of the charter of 1857. The request stated that the right to construct and operate underground wires and use electricity for lighting purposes was authorized by section 5 of the charter, which authorizes the company to "make and sell any substance or material that may be now or hereafter used as a substitute for gas." To this request the street commissioner replied that he could not issue a permit until the case was made plainer to him. Other requests of similar import were refused by the street commissioner. The result of this is that the Laclede Gas company has filed mandamus proceedings in the State Supreme Court at Jefferson City by which it expects to compel the street commissioner to issue a permit authorizing it to excavate the streets for laying electric conduits. The city counselor states that the court will have to decide whether electricity is a substance; whether it is a perfect substitute for gas; whether the charter of 1857 covers the construction of electric conduits and subways; whether the charter of 1857 is valid or expired in 1887 with the issue of a new charter; whether section 2,721 of Revised Statutes, State of Missouri, 1889, which forbids the placing of wires underground in any city without consent of that city, does not restrict the company in spite of the charter of 1857. Aside from these questions there is another technical quibble which may arise; that is, what was the broad intent and purpose of the words "to make and sell any substance or material that may now or hereafter be used as a substitute for gas." It will be recalled that as late as 1857 it was not uncommon to consider electricity as a fluid.

A bill is now before the Municipal Assembly asking for a 50 year franchise for a new telephone exchange company. The promotors of the scheme are J. A. J. Shultz, Jas. M. O'Shea, Andrew Haley, S. Ricord Gradwell, Louis J. Oswald and Wm. J. Kurtz. The bill provides for telephone service by means of underground or overhead wires, as the city may require. The annual rental charge is fixed at $60 for office and $48 for residence service. The petitioners also agree to furnish to the city free of charge the use of 40 telephones in consideration of the franchise.

The conduit trolley system in Washington, D. C., and the conduit work now being installed by the Metropolitan Traction company in New York city have again called attention to the conduit trolley question. Charles Green, president of the People's Railway company, is considering the matter carefully with a view to using the system if found satisfactory.

Some time ago the Bell Telephone company began the erection of a line of poles in the middle of Union boulevard. Charles H. Turner, president of the St. Louis & Suburban Railroad company, having a branch line to Forest Park on Union boulevard, objected to this proceeding and secured an injunction stopping the work. This entanglement resulted in the street commissioner writing to the presidents of both companies suggesting that all wires be put underground on that boulevard—that is, the telephone wires to be laid in a conduit and the street car company to operate a conduit trolley. At first this suggestion was not taken very kindly, the practicability of a conduit trolley being doubted. But after some further consideration the St. Louis & Suburban Railroad people have ventured to say that if they find the conduit trolley system is practicable they will give it a trial.

R. J. H.

## PERSONAL.

Frank X. Cicott, manager of the railway department of Pettingell Andrews company of Boston, sailed on the steamship Lucania on December 1st for Europe, in connection with the girder rail business with Dick, Kerr & Co., London.

William Hood, one of the most experienced electrical salesmen of the West, has been appointed western selling agent of the Accumulator company, with an office at 239 La Salle street, Chicago.

W. H. Train, manager of the Water, Light & Power company of Hot Springs, S. D., was in Chicago last week. Mr. Train says that there is no doubt of the consummation of the electric railway project in his town.

Amherst E. Wilder, who died recently, was one of the most prominent citizens of St. Paul, Minn. Mr. Wilder had been in ill health for the last three years and when his illness took a more serious turn about three weeks ago complications set in that baffled medical aid. He was president of the Superior Water, Light & Power company of West Superior, Wis., which position he had held since the inception of the company, and to his ability as a financier the success of that corporation is largely due. At a meeting of the directors of that company on November 20th appropriate resolutions of sympathy and condolence were adopted.

## ELECTRIC RAILWAYS.

Fire recently broke out in the barns of the Allegheny Traction company at Pittsburg. Forty-nine horses, seven horse cars and seven electric cars were burned. Three dwellings adjoining were also destroyed. The entire loss is about $75,000.

It may yet be possible for a Welsh electric car conductor to call out: "All out for Llanfairpwllgwyngyl," as the London *Electrician* understands that a scheme is under consideration for the construction of a light railway from Menai Bridge or Llanfairpwllgwyngyl to Beaumaris, Anglesea, and surveys of both routes have been completed. At present communication between Beaumaris and the neighboring towns is restricted to ferries and roads.

Work was commenced upon an electric street railroad in Oshkosh, Wis., on December 1st. According to the terms of the franchise eight miles must be completed within four months and twenty miles before January 1, 1896. The promotor of the enterprise is J. K. Tillotson of Toledo, O. He is backed by Chicago capital. A stock company, with $1,000,000, is being formed to put in not only a line in Oshkosh, but an interurban road from Oshkosh to Kaukauna.

The stockholders of the Chicago General Railway company met on November 26th at the power plant at 1030 Lawndale avenue. The stock-holders of this company and those of the West & South Towns company are identical. The West and South Towns company was organized in August, 1892. The General company was organized in May, 1894. The latter took a lease of the former's road, giving in consideration 6 per cent. interest-bearing bonds and its own stock, share for share. C. L. Bonney is the president of the West & South Towns road, and Lawrence E. McGann of the General company. Lawton C. Bonney is secretary of both corporations. At the meeting referred to it was decided by the stockholders of the West & South Towns company that dividends for the year 1895 should be paid by the General company and not by the other. The coupons for rent of the older company's line, maturing May 1st and November 1st had been canceled for 1894 and 1895 and no dividend has been paid by the new road. A statement that was sent to stockholders showed the surplus that had thus accrued to amount to $20,000. This, it was agreed, should be used to take up the company's bonds instead of turning it over to the Towns company. The report to stockholders showed that 140,147 miles had been run by the company's cars from May 1 to October 31, 1894, inclusive. Six hundred and fifteen thousand and twenty-four passengers had been carried. The cost of operating per car per mile was 10.8 cents. At the time of the report the double track had been extended five and one-half miles. The General company is building a large power plant, car house and repair shop at Kedzie avenue and Thirty-first street. It has a capacity for 125 cars and for engines aggregating 2,400 horse power.

## MISCELLANEOUS.

A Wilkesbarre, Pa., dispatch says: The problem of utilizing the immense culm piles in the anthracite coal region is about solved The culm constitutes the waste from the hard coal after it is crushed in the breaker. There are millions and millions of tons of this culm laying waste. Capitalists with headquarters in Scranton and Wilkesbarre will use the culm for boiler fuel to generate electricity, which will be transmitted to New York, Brooklyn, Philadelphia, Paterson and other towns. The power, which can be used either for motive, heating or lighting purposes, will cost the consumers less than $7 per horse power a year.

It is said that the two fields in which the electric motor has of late made greatest inroads are those of mining and of iron manufactures, and that in these the developments compare in importance, if not in magnitude, with the advances in electric railroading. In mining there is a great range of application, including underground tramways, elevators, pumps, ventilators, drills, coal cutters, etc., and all branches are being actively exploited. A large quantity of American electrical mining apparatus finds its way to South Africa, and a brisk demand is now springing up in the eastern world. In iron and steel works throughout this country the resort to electrical power, is remarkable. Large numbers of them use electrical cranes and electrical power distribution plants may be found in the great manufacturing plants of the country.

The *St. Louis Globe-Democrat* describes a toy electric boat which is 26 inches in length and 6½ inches beam, and is guaranteed to beat any other boat of its size. It is driven by a tiny motor and one cell of special boat battery. The motor is suspended on a bracket and geared direct with the propeller shaft. Motor, gearing and battery can all be taken out and replaced within a minute. The battery gives enough current to propel the boat between one and two hours. It gives no trouble whatever, as from its construction there can be no tipping over of acid and no breakage of glass jars. The boat travels at the rate of about three miles an hour. The propeller is 2¼ inches in diameter and has two blades set at a 45 degree pitch. The whole appearance of the miniature craft is trim and workmanlike; in fact, it has been designed and built under the direct supervision of a United States naval engineer. It is claimed that as an easy running boat it cannot be equaled.

## TRADE NEWS.

Thomas G. Grier and Edward R. Grier, managers for the western office of the Bryant Electric company, who also represent the porcelain business of R. Thomas & Sons company, have had a busy week arranging their new storerooms in the Monadnock building, Chicago.

The Electric Appliance company is hard at work on an inventory which marks the beginning of its fourth business year. This event will be duly celebrated as soon as possible by the issue of several sets of advance sheets to the company's new issue of general catalogue. The catalogue itself is expected to be ready for distribution early in the spring, and it is promised that it will be a veritable "chap book" among catalogues.

## BUSINESS.

The increasing business of the Washington Electric company, 207 South Canal street, Chicago, has compelled that thriving concern to double its floor space. The company has rented the rooms adjoiningits former shops, where it is admirably adapted for turning out work efficiently and with despatch.

The Knott Manufacturing company, 796 Seventh avenue, New York, gives the following seven reasons why its commutator lubricating compound should be used: It prevents sparking; it prevents overheating; will not run or gum; saves brushes; increases life of commutator; will not clog the brushes; gives commutator a hard, brilliant polish.

The Mather Electric company of Manchester, Conn., has just closed a contract with the Overman Wheel company for an electric power transmission at Chicopee Falls, Mass., consisting of one 100 kilowatt new type multipolar generator, two 25, one 20 and two 10 horse power Manchester motors, with complete switchboard. The Mather company is also installing a similiar plant with a 60 kilowatt generator in the mill of the Connecticut River Paper company at Holyoke, Mass. It has also hooked the following orders: 60 kilowatt new type multipolar generator for the Pierpont Manufecturing company, New Bedford, Mass. (third order); 350 light dynamo for the receivers of the Union Pacific Railroad company, Pocatello, Idaho; 350 light dynamo for the Rockwell Manufacturing company, Milwaukee, Wis.; 350 light dynamo for the Hub goremakers, Brockton, Mass.; 100 kilowatt railway generator for the Ithaca Street Railway company, Ithaca, N. Y.; 45 kilowatt direct-connected dynamo, with Ideal engine, for the Wayne hotel, Detroit, Mich.; 350 light dynamo (ring type) for the Meriden Britannia company, Meriden, Conn.; 350 light dynamo for the Berlin Iron Bridge company, East Berlin, Conn.; 150 light dynamo for Burtis & Howard, Minneapolis, Minn.; 250 light dynamo for C. Dorflinger, White Mills, Pa.; 150 light dynamo for H. B. Coho & Co., New York city; 15 Manchester motors, from 3 to 15 horse power.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued November 27, 1894.*

529,688. Means for Supporting Motors in Electric Locomotives. Walter S. Adams, Philadelphia, Pa. Application filed November 9, 1893.

An electric motor is sustained beneath the body of a car or vehicle by a pair of longitudinally extending bars; cross bars are secured to the side bars of the truck between the wheels, and hangers depending from the cross bars, the longitudinal bars having a support upon the hangers. The motor is detachably secured to the longitudinal bars at their ends, the end of the motor opposing such connection being geared to and carried upon one of the axles of the car or truck wheels, as shown in the illustration.

529,704. Closed Conduit Electric Railway. Charles G. Burke, Brooklyn, N. Y. Application filed February 10, 1894.

In this arrangement there is the combination with a line of rails from which the car motors are arranged to receive current, and contact terminals in a conduit beneath the track connected at intervals with the rails, of an insulated supply conductor in the conduit, insulated movable terminals connected therewith at intervals, and extending through openings into a lower chamber in the conduit, an arm extending from a car into the lower compartment, a series of levers in the lower compartment with which the arm engages and adapted to raise the terminals successively upward into contact with those connected with the rails, and a spring acting on the arm and tending to raise it from the conduit.

529,710. Sectional Thermo-electric Generator. Harry B. Cox, Hartford, Conn. Application filed January 31, 1894.

The thermo-electric generator built up of interchangeable sections secured together by a surrounding metal jacket, each section being suitably coated and provided with its own metal jacket, the jackets of the various sections being united.

529,711. Thermo-electric Generator. Harry B. Cox, Hartford, Conn. Application filed January 31, 1894.

The cut shows a thermo-electric generator having a surrounding water jacket, a liquid tank beneath provided with heating means, and having a stand-pipe extending upwardly through the center of the electric generator, so that the heat stored in the tank will be conveyed to the inner surface of the generator.

529,759. Electric Signal for Railway Crossings. Danie W. Smith, St. Louis, Mo. Application filed September 10, 1894.

An electric crossing signal, comprising a bare conductor to be engaged by the trolley of a moving vehicle, a crossing bare conductor arranged at an angle with respect to the first mentioned conductor, signal wires located parallel and adjacent to the conductors, but electrically separated therefrom and extending a distance on each side of the crossing point, so that a trolley approaching the crossing in either direction on either conductor may operate a signal. A signal is connected to the signal wires, and a crossing clamp having locking grooves or recesses secured to one of the conductors solely by frictional contact, and detachable therefrom by revoluble movement.

529,784. Commutator Brush for Dynamos. George Forbes, London, Eng. Application filed August 8, 1892.

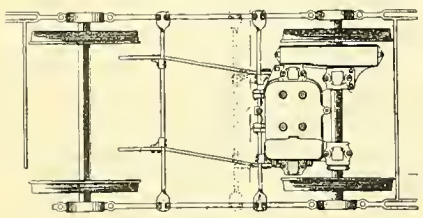
In the cut is shown a mass of flexible carbonized material, and a metal box serving as a holder, the flexible material forming one terminal of an electric circuit, a corresponding terminal and a thumb-screw for pressing the flexible material against the corresponding terminal.

529,811. Railroad Signal. Charles Selden and Frank P. J. Patenall, Baltimore, Md. Application filed December 18, 1893.

A semaphore, and a controlling or actuating disk therefor, a lever carrying a catch or detent for engagement therewith, an auxiliary power wheel coaxial with the controlling disk, an electro-magnetically governed catch for auxiliary power wheel, and links connecting the power wheel with the lever carrying the catch for the controlling disk, are features of this invention.

529,812. Railroad Signal. Charles Selden, Baltimore, Md. Application filed January 4, 1894.

In this railroad signal apparatus there is the combination with the signal releasing magnet of a signal which is set into positions of safety and danger by successive operations of the magnet, a relay magnet, circuit-controlling devices therefor governed by a passing train, and means for producing a double change of circuit condition in the signal magnet by a single change in the electrical condition of the relay magnet.



NO. 529,688.

529,818. Telephone. Alfred Stromberg and Androv Carlson, Chicago, Ill. Application filed October 9, 1894.

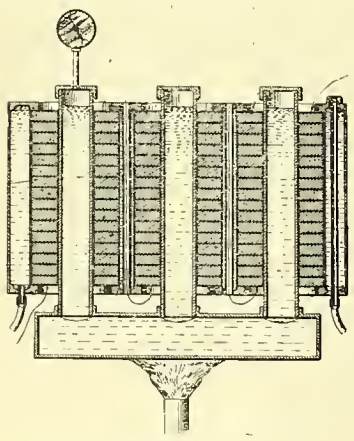
In the accompanying illustration there is shown a hand telephone, a casing *a*, a diaphragm support *b* adapted to be adjustably screwed upon the casing, the casing *a* being provided upon the rear with a projection *a'*, the cores $c^1$ $c^2$ and the permanent magnet *d* secured to the projection, the cores $c'$ $c^2$ extending through the bottom of the casing and carrying upon their ends the telephone coils $c^3$ $c^4$

529,826. Telephone Switch. Edgar S. Combs, Rochester, N. Y. Application filed October 9, 1894.

The principal features described in the invention are: A plate having a slot therein, an arm carrying the insulated block and contacts, an arm projecting from the front of the plate and slotted or cut away to receive the eye of the telephone receiver, and a lever pivoted to the arm and provided with contact plate and hook.

529,829. Trolley Wheel. Frederick Lepper and William Wighton, Toronto, Ont. Application filed September 22, 1893.

A trolley wheel comprising the body portion, having an exterior wire-receiving groove and a chamber divided by integral radial walls or ridges into a plurality of segments, the walls extending from the interior projection of the groove and tapered upon opposite sides toward the center of the wheel and the tapers extending upon both sides from the peripheral edge of the walls to the central point and at right angles to the axis of the wheel, a hollow bushing in the center of the wheel with radial openings opposite the points of the walls and in the same radial line, the points extending into close proximity to the openings, a tube seated in an opening in the side of the wheel and having a plurality of openings near its rear end, a rubber ball valve arranged in the tube and adapted to be seated against the partially closed outer end thereof, and the spring bearing against the ball and at its inner end supported by one of the ridges, against which also the tube rests at its inner end



NO. 529,711.

529,836. Conduit Electric Railway. Leonidas C. Pressley, San Francisco, Cal. Application filed February 6, 1894.

The last claim reads as follows:
In an electric railway, trolley rails extending in an underground conduit and made in independent insulated sections, an electrical conducting wire extending parallel with the line of track and within a sealed and insulated containing tube, transverse passages extending from said tube to the conduit, insulated rods slidable therein, having magnets which, when energized, act to move the rods into contact with the rails, and devices whereby said movement forms contact simultaneously with the conducting wire, disengaging mechanism by which the rod is moved backward as the trolley passes the joint between two meeting rail sections, and a brush or contact piece with which the rod makes contact when thus moved backward, whereby any electricity with which the trolley rail and rod may be charged is grounded.

529,898. Rotatable Electric Contactor. John W. Curry, Cairo, Ill. Application filed July 9, 1894.

A rotatable electric contactor combining an insulating base, annular contact plates concentrically disposed on this base and insulated from each other, a shaft rotatable in the base, brackets removably secured to the shaft, insulating arms adjustably mounted in the brackets, wheel frames having shanks vertically adjustable in the insulating arms, shafts secured in these frames and connected in the local circuit, and contact wheels journaled on the shafts with which they are in electrical contact and bearing on the annular contacts of the base.

529,903. Trolley Wire Support and Coupling. Aaron P. Gould, Canton, O. Application filed March 7, 1894.

A trolley wire support, the body portion having at its lower edge a projecting ledge, a cap having elongated apertures, and the binding screws, are described.

529,918. Alternating Current Generator. John F. Kelly, Pittsfield, Mass. Application filed August 18, 1894.

This invention is described as an alternating current generator, having a single exciting coil and a suitable armature, and two groups of unlike field pole pieces on opposite sides of the exciting coil, the faces of said pole pieces being so shaped that their curvature referred to the opposing armature surface may be expressed by the formula—

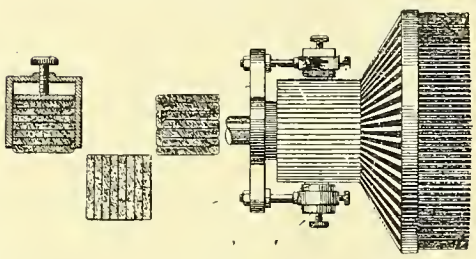
$$A' = \frac{A}{\text{Cos. } \frac{1}{2}\pi \frac{L'}{L}}.$$

529,920. Signal for Cable Railways. Gottfried F. Klaffky and Frank Faltinowsky, New York, N. Y. Application filed May 8, 1894.

The last claim is given:
In a railway, the combination with a conduit, a car, and an electric circuit, including a signal and a circuit controller, of a vertical shaft mounted in a bearing on the truck frame, and having an arm to operate the circuit controller, and a second shaft having a bearing in the car body and coupled to the first shaft to permit oscillation of the car body without interference with the first shaft.

529,938. Electrical Recording Device for Safes. Robert A. Newlyn, Cincinnati, O. Application filed April 28, 1894.

A safe, an air-tight safe protecting compartment, a pressure gauge and a rotary pointer, a fixed terminal adjacent to but insulated from the gauge, and with which the pointer is adapted to come in contact, an electric circuit connected with the pointer and fixed terminal, a clock controlled circuit making and breaking mechanism located in the same circuit and within the safe compartment, an alarm located in the circuit outside the safe protecting compartment, and means for changing the normal pressure of air in the compartment, are described.



NO. 529,784.

529,949. Electrical Danger Signaling System. William A. Phillips, U. S. Army. Application filed May 29, 1893.

In an electrical signaling device for block system railways there are three parallel track conductors for each block, the central one of each block being electrically connected with one of the conductors of each adjacent block at opposite sides, and conductors carried by a car, one of which is connected with a battery on the car and the central track conductor, and the others connected with a bell in the car and with side-track conductors.

529,984. Electric Signal Apparatus. Horace E. Walter, Richfield Springs, N. Y. Application filed January 9, 1893.

This is an arrangement in which a series of radial lines connect sub-stations or boxes with a central station, each containing a signal transmitter and a resistance, and a switch for removing the resistance during the transmission of the box signal, a resistance coil in each line at the central station, a commutator for successively shunting the resistances, an electro-magnet controlling the operation of the commutator, operated from the sub-station, a battery in the shunt circuit too feeble to overcome the resistances at the boxes, a make-and-break wheel also in the shunt circuit, a normally wound motor therefor, and an electro-magnet in the shunt circuit for releasing the motor, and locking the commutator arm when it closes on that line in which the resistance at the box has been removed, a signal receiver, and an electro-magnet for operating it, responsive to the action of the make-and-break wheel.

529,985. Electric Signaling Apparatus. Horace E. Walter, Richfield Springs, N. Y. Application filed March 26, 1894.

Several normally open branch lines radiate from a central office and have a common return. The arrangement includes a battery, a circuit-closer for each branch line at a distant point, and a resistance for each branch line at the central office, a commutator at the central office comprising a series of terminals connected with open branch lines, and a circuit-closing arm adapted to successively engage the terminals, and thereby successively shunt the resistances, a motor for rotating the arm, an electro-magnet for releasing the motor operated by a closure of any branch line, an electro-magnet in electrical connection with the circuit-closing arm which operates to stop the motor when the circuit closing arm engages that terminal connected with a closed branch line, a telephone in each branch line at the distant point, and a telephone at the central office adapted to be connected with the circuit.

529,986. Electric Signaling Apparatus. Horace E. Walter, Richfield Springs, N. Y. Application filed April 26, 1894.

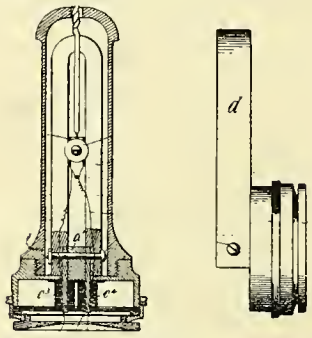
The invention comprises a series of signal boxes, independent wires connecting them with a central station, a box selecting device at the central station set in motion by the operation of any one of the signal boxes, and stopped when the particular box operated has been selected, a re-transmitting apparatus set in motion upon the stopping of the box selecting device, comprising a series of circuit controllers, one for each signal box, a circuit operated by the re-transmitting apparatus, and indicating apparatus operated by said circuit.

529,992. Conductor Coil for Armatures and Field Magnets and Method of Making Same. Emra W. Alexander and Henry Groswith, Philadelphia, Pa. Application filed September 22, 1893.

The improvement described consists of winding the conductor upon a core or spool, covering the layer of conductor so formed with enamel, depressing the enameled surface into grooves for receiving the second layer of winding, winding a second layer of conductor in such depression or grooves, covering the second layer of conductor so formed with enamel, and thereafter, when the required number of layers have been wound, subjecting the enameled coil to heat.

529,999. Switchboard. Louis A. Berthon, Paris, France. Application filed October 17, 1893. Patented in France January 31, 1893.

In multiple switchboards for telephonic systems there are a plurality of spring-jacks, and a frame carrying them and having tracks, in combination with a plurality of connecting springs, and a band carrying the connecting springs and engaging and sliding in the tracks of the frame.




NO. 529,818.

530,004. Electrical Contact Mechanism. John F. Blake, New Haven, Conn. Application filed June 21, 1894.

A base or support and a pressure actuated index, combined with a circuit-closer actuated by the index, an electro-magnet, an arm ture actuated by the electro-magnet, and a second circuit-closer composed of an arm or shaft carried by the armature, an eccentric disk rotatably mounted on the shaft, and contacts placed within reach of the eccentric disk and serving to turn the latter and cause it to make accurate contact with both contacts.

530,020. Apparatus for Welding Rings. Charles L. Coffin, Detroit, Mich. Application filed March 13, 1894.

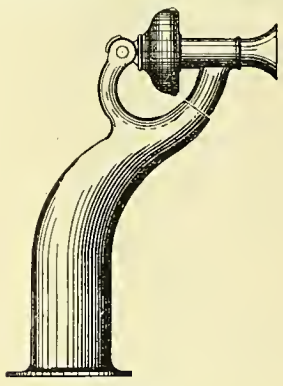
In an apparatus for electrically heating metal a separable clamp is provided for holding the article to be welded; also means for opening and closing the clamp, a movable furnace, a movable anvil, and connecting mechanism for moving the furnace toward the clamp, and moving the anvil in proper relation to the clamped article.

530,021. Method of Electrically Heating Metal. Charles L. Coffin, Detroit, Mich. Application filed July 10, 1894.

The method of electrically heating metal described consists in bringing the metal in circuit with a liquid electrode containing a substance more volatile or vaporizable than water.

530,032. Electric Elevator Motor. Wendell C. Fletcher, St. Louis, Mo. Application filed June 14, 1894.

A system for controlling an electric motor consisting in an independently multiple wound armature, in combination with a sectional series field and a shunt field producing a counter-electromotive force equal to the normal when first starting the motor, suitable wires and switches, and means for operating them to constantly maintain the counter-electromotive force as the speed of the motor increases, is described.



NO. 23,825.

530,033. Supply System for Electric Railways. Zebulon Foster, Chicago, Ill. Application filed March 7, 1894.

An electric railway, comprising a line conductor having a series of branches, a conductor comprising independent sections arranged opposite the terminals of the branches, the contact blocks, springs for holding the sections and branches normally separated, and a trolley mechanism for producing the required engagement.

530,053. Electric Robe, Towel, etc., for Heating. Henry G. O'Neill, Boston, Mass. Application filed April 9, 1894.

A towel, robe, or other article of flexible fabric is provided with a flexible resistance contained within the same, the resistance having water-proof and fire-proof coatings, and being adapted to connect with the conductors of an electrical circuit.

23,825. Transmitter Post for Telephones. William Gray, Hartford, Conn. Application filed August 30, 1894.

The claim is given:
The design for a transmitter post substantially as herein shown.

# Western Electrician.

EVERY SATURDAY.

Vol XV. CHICAGO, DECEMBER 15, 1894. No. 24.


## Electricity in Sinai Temple.

Sinai Temple, at Indiana avenue and Twenty-first street, Chicago, is the home of the most important and influential Jewish congregation in the western metropolis. It is a substantial and handsome stone building containing an auditorium capable of comfortably seating 2,300 people, assembly and recitation rooms for Sunday and day schools, lecture hall, pastor's study, directors' room, kitchen, and in fact all departments needful for the ethical, educational and social features of the society's work. The congregation is wealthy, and in Dr. E. G. Hirsch it has a cultured and broad-minded leader. Its theology is very liberal; the principal services are held on Sunday, and several Christians are regular attendants. The appointments of the building are complete and in good taste; and, in keeping with the advanced and modern air observable throughout the whole establishment, electricity is used for lighting and such power transmission as is needed.

The lighting of the auditorium is very effective, and the general impression made on the eye of the observer is only imperfectly represented in the illustration herewith presented. A central arched dome runs the length of the longer dimension of this large apartment, and in it are suspended five ball clusters of incandescent lamps, each containing 32 lights of 16 candle power. On either side of this vaulted opening are seven small ceiling domes, hemispherical in shape, each containing a ten-light fixture placed in the highest portion of the arch. There are thus fourteen small circular domes, and as they are tinted a light color, with the lamps concealed from view by the curvature unless the observer is directly underneath, each shows a circle of diffused light, the whole blending in a very pleasing effect. There are also bracket fixtures about the walls, those above the galleries supporting five lamps and the lower ones three each. On the platform there are two 32 candle power reading lamps supported on upright wrought-iron standards and supplied with ornamental screens of silk and lace. The lamps are all connected on the three-wire system, and the auditorium circuits are controlled by knife switches in a wall-closet located in the passageway in the rear of the speaker's platform. The other portions of the building are also amply supplied with incandescent lamps, snap switches being conveniently placed in the various hallways and in the organ-loft. In all there are 670 lamps, and the fact that the fixtures alone cost $3,000 shows the elaborate and careful character of the work. Direct, low-pressure current is obtained from the service mains leading from the Twenty-seventh street station of the Chicago Edison company.

Unobtrusive switches arranged for both hand and foot pressure are placed on and about the reading desk, so that Dr. Hirsch is placed in electrical communication with the choir above and with the ushers at the main entrance. The signals are given by low-sounding buzzers.

Heating and ventilation are secured by drawing in fresh outside air and then forcing it through coils of steam pipes or over blocks of ice, as the case may be, and distributing it from a basement tunnel to various points in the auditorium and other rooms. Steam radiators are also used to a limited extent. The blower which is used for circulating the heated or cooled air has a fan nine feet in diameter and is belt-driven by a Sprague 20 horse power electric motor, as shown by the small illustration at the left in the group picture. The blower was supplied by the Buffalo Forge company. The fan blades are three and one-half feet wide and are driven at 185 revolutions per minute. At the farther end of the building there is also a 10 horse power Edison motor belted to an exhaust fan. All the steam heating apparatus was furnished by the L. H. Prentice company of Chicago.

The electric organ blowing equipment, illustrated at the right in the picture, is similar to other installations of this character that have been described in this journal. A two horse power motor made by the Detroit Motor company drives, by a double reduction of shafting and belts, a shaft operating the organ bellows, which forces air into the pressure bellows under the organ. When the first bellows rises it draws up with it a contact arm which gradually cuts in resistance sufficient to almost stop the motor. Then, as the air is used and the bellows falls, a counterweight brings the contact-arm down with it, thus cutting out the resistance and again starting the motor in active operation. Once started, the motor and bellows are thus automatic in operation and need no further attention until shut down.

R. H. Little is the electrician and mechanician in charge of this plant.

Heating and Ventilating Motor. Auditorium Lighting. Organ Blowing Attachment.

ELECTRICITY IN SINAI TEMPLE.

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An electric street railway is to be built in Batavia, N. Y.

## Western Telephone Construction Company's Switchboard.

The accompanying illustration represents the telephone switchboard recently installed at Cambridge, O., by the Western Telephone Construction company for Hoyle & Scott, owners of the exchange at that place. The board is arranged to afford connection between 200 instruments, 100 for each panel, and the proprietors of the exchange have already 135 telephones in operation. The business is constantly increasing, as is shown by the fact that the exchange was opened last June with less than 100 subscribers. The board on the left in the picture shows the lightning arresters. The switchboard as a whole is noticeably compact, and it is satisfactory in operation.

The Western Telephone Construction company has 3,500 exchange instruments in operation and 500 private telephones. The Minnesota Iron company has, it is stated, discarded the Bell instruments and replaced them with the telephones of this company, using six instruments and 102 miles of circuits.

## Receivership for the Great Western Company.

Judge Grosscup of the United States Circuit Court has appointed E. H. Fowle receiver of the Great Western Manufacturing company on application of counsel for Mrs. Mary J. Lamb, the creditor in whose favor the company confessed judgment. Mr. Fowle has been employed by the company, but is not interested in it in the sense of being a stockholder or director. As the Chicago store, with all its contents, was transferred to the First National Bank of Chicago by a bill of sale prior to the confession of judgment, the receiver will have no control of the assets therein contained.

The daily newspapers contain the information that Judge Morton of Boston has granted a temporary injunction restraining the American Loan & Trust company from disposing of bonds or proceeds of bonds sold and at present held under an agreement relative to the Great Western Manufacturing company. It was stated in court by S. L. Whipple, counsel for the Eastern Electric Cable company, a creditor of the Great Western Manufacturing company, that there had been an issue of $100,000 in bonds secured by the plant of the company in Duluth. These bonds were held by the trust company, and $80,000 has been sold. There is $20,000 remaining, and Mr. Whipple did not wish to run any chance of the bonds or their proceeds being turned over to the receiver of the Great Western company or to anyone else. It appears that notice of the suit had been given the trust company, which did not appear. Judge Morton issued the temporary injunction. Mr. Whipple's bill further asks that the trust company sell the bonds and later devote the proceeds to the payment of plaintiff's claim.

The Merchants' National Bank of St. Paul has attached the plant of the Great Western company at Duluth for $10,596.75.

The stockholders of the electric railway company at Springfield, Mass., have voted an increase of $250,000 in capital stock. The building of the power house and the Liberty street extension are the causes assigned.

## Gas as an Illuminant.

By Foree Bain.

Intellectual development keeps pace with the improved methods of producing light, or light becomes necessary to a higher development of the intellect. It does not require a philosopher to note the fact that the light of intelligence sheds its most effulgent rays where artificial light has been most highly developed.

In looking back over the period during which the electric light has had its birth and growth, the most characteristic phase of its history is exhibited in the influence it has had in the demand for more light and better light.

In the beginning the electric light did not enter the arena with gas in the struggle for supremacy on a basis of economy, and it has never been a competitor with gas, but it has occupied a field entirely alone. The advantages and the quality of the light when compared with gas were so manifest that, notwithstanding its higher cost, it was at once adopted by the most enterprising and progressive people. When considering light this is certainly not a cheap age. The public wants the best light and plenty of it, and is willing to pay for it.

Electric light is not more comparable to gas as an illuminant than gas is to kerosene or kerosene is to tallow candles—they all have their use, and as Betsy Bobbett says, they have their "speres."

We do not now find the large stores lighted with a dozen kerosene lamps because they are cheaper than gas, nor do we find them lighted with a few fish-tail gas burners because they are cheaper than electric light, but we find them as brilliant as day with the best light that skill and knowledge can produce.

The electric light stands to-day preëminently the highest standard of excellence that has been attained in the development of artificial illumination.

The introduction of electric light has done more for the gas companies than they have ever done for themselves. It has increased the consumption of gas, by the growing demand for more light; the number of customers that the gas companies have lost through the electric light has been more than compensated for by the increased consumption of gas by others. It has stimulated the gas people to devise better methods and to improve their old methods of illumination. Occasionally their success has led them to believe that they were really and actually competitors in the choicest fields of illumination.

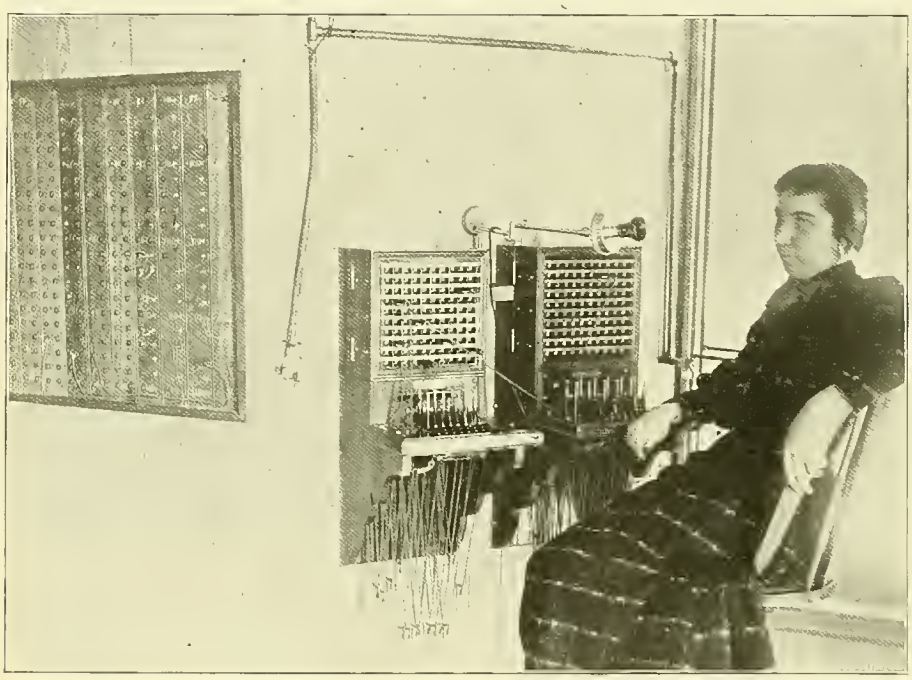
Several years since the Siemens-Sugg gas burners were introduced in this country with a flourish of trumpets and the confident announcement that the death of the electric light was a matter of a short time only. The large burners, which resembled bonfires more than anything else, got in their work on their poor deluded victims when the warm days of summer-time came. The products of combustion were so great that each of these burners required a six-inch stove-pipe to carry it to the flue, and had the warm days not worked destruction to this nice little winter scheme, no doubt the society for the suppression of smoke would have come to the rescue.

And now we have another winter scheme in the revival of the Welsbach burner. It is a matter of note that the attempt to introduce this lamp again has been made in the fall of the year, at a time when heat is very desirable and when the great amount of heat given out by these burners may be turned to some useful account; but in the summer-time, when the scorching days have come and when the nights are no improvement on the days, and when the gentle breeze is conspicuous by its absence, how many Welsbachs will we see? 'Tis then the ash barrels will groan with their burden of discarded Welsbachs.

Without going into the question of comparing the merits of the incandescent electric light with that of this would-be rival, the so-called incandescent gas lamp—the Welsbach—we will admit that the Welsbach will give more light for less money than the electric light, on the basis of the figures and claims of the gas companies, and if quantity and the cost per unit were the only requirements we must admit at once that the advantages are in favor of the Welsbach; but fortunately quality counts for more than quantity with the greatest numbers of persons accustomed to the use of artificial light.

There are so many reasons why the Welsbach is destined to be short-lived that it is not necessary to enter further into discussion of the subject. It is only necessary to say that the deflection is spasmodic and that next year the managers of electric light plants may prepare to largely increase their capacity, as the fad will simply stimulate a demand for more electric light, and by next fall the use of electric light will become more general than ever before, after the memory of Welsbach has past into history.

It is my opinion that gas will never enter the field as an equal competitor with the electric light as an illuminating agent, but I earnestly do believe that it will be a valuable adjunct toward the cheaper production of electric light when used as fuel to drive gas engines with which to turn the dynamos.



WESTERN TELEPHONE CONSTRUCTION COMPANY'S SWITCHBOARD.

## Important Storage Battery Consolidation.

It is stated on authority that appears to be beyond question that the Electric Storage Battery company of Philadelphia, manufacturer of the chloride cell, has purchased the Brush accumulator patents from the Consolidated company. It is further asserted that these patents have been purchased merely owing to legal entanglements, and that the Electric Storage Battery company will continue to exploit the chloride battery. These statements have not been officially confirmed, but they have obtained general circulation among the members of the electrical fraternity. If they are fully borne out by later developments, this step marks an important epoch in the storage battery industry in the United States, as the Electric Storage Battery company will have a practical monopoly of the field, save in the manufacture of Planté cells. A press dispatch, dated at Philadelphia, December 4th, gives these details:

A financial deal of considerable importance has just been consummated whereby the Electric Storage Battery company of this city has acquired all the rights, patents, etc., of the Consolidated Electric Storage company, the battery patents and rights of the Brush Electric company of Cleveland, the battery patents and all interests in connection with batteries and the good will of that branch of the business of the General Electric company, all the property, rights, patents, etc., of the General Electric Launch company and the Electric Launch & Navigation company, and the right, licenses and patents of the Accumulator company.

The completion of these purchases virtually places in control of the Electric Storage Battery company all its former competitors in the business of supplying storage batteries, and puts an end to all litigation over patent rights. A large proportion of the stock of the Electric Storage Battery company is owned by the United Gas Improvement company, and the same people are interested in the management of both. The proposed new issue of stock to provide cash capital for the company to the amount of $500,000 has all been underwritten at $50 per share by a syndicate of well-known financiers.

## Telegraph Historical Society

The recently circulated call for a meeting of those interested in the formation of a historical telegraph association brought together a number of gentlemen in the Board of Trade rooms in Washington on December 5th. The Telegraph Historical Society of North America, which has for its object the collection, publication and preservation of historical data concerning the birth and progress of the telegraph in North America, was organized with a membership of about 250, representing all sections of the country. The following named officers were elected: President, Alonzo B. Cornell, Ithaca, N. Y.; first vice-president, S. H. Kauffmann, Washington; second vice-president, William B. Wilson, Philadelphia; third vice-president, Thomas D. Lockwood, Boston; secretary-treasurer, George C. Maynard, Washington; directors, J. H. Emerick, New York; B. F. Dillon, Jacksonville, Fla.; W. R. Plum, Chicago; J. O. Mason, Tacoma, Wash.

On December 22d the plant of the Charleston, Miss., Electric Light company will be sold at public auction.

## Electric Conversion System.

The accompanying cuts illustrate a new system of electric conversion and distribution devised by Ludwig Gutmann of Chicago. A self-starting harmoniously running motor adapted to run under the influence of single-phase alternating currents is utilized, two armature windings being provided, in one of which are produced biphase or polyphase currents which react upon a magnetic field to maintain the rotation. In this arrangement the motor is combined in a motor-generator, commutating the biphase or polyphase currents, and passing the continuous current thus produced through a working circuit containing translating devices. If the supplemental winding be directly connected with the main winding, the constant current produced will have the potential of the supplied alternating current, while if the supplemental winding be connected with a secondary main winding, the potential may be transformed up or down as desired. Instead of providing a secondary winding the potential may be transformed by connecting as an induction motor.

Fig. 1 illustrates diagrammatically a system of distribution. Fig. 2 illustrates a modified form of a motor-generator. In the cuts the source of alternating currents as shown at $a$ is connected by the mains $a'$ $a^2$ with the several consumption circuits. The primary of the converter $b$ is shown connected between the mains $a'$ $a^2$, translating devices $b'$ $b'$ being included in the secondary of the converter, and, in consequence, being supplied with an alternating current. The motor-generator $A$ is provided with two magnetic fields $c$ and $d$, a main armature winding $e$ being adapted to rotate in the field $c$, while a supplemental winding $f$ is adapted to rotate in the field $d$, the two windings being mechanically connected and rotatable together. The motor is of the shunt type, the field coils $c'$ being connected in parallel with the armature, the coils of which are connected with the segments of a commutator $e'$, upon which rest the brushes $e^2$ $e^3$. The coils of the main winding $e$ are connected with the coils of the supplemental winding $f$ by means of conductors $g$, shown extending between the centers of the coils, but which may extend between any intermediate points of the coils. The coils of the supplemental winding are connected with the segments of commutator $f'$, upon which rest brushes $f^2$ $f^3$, to which are connected the opposite sides of the consumption circuit containing the translating devices, as for instance, storage battery $h$, lamps $h'$ and motor $h^2$. Switches $h^3$ may be provided so that the consumption circuit may be disconnected from the motor-generator and the translating devices supplied by the charged storage battery. The field coils $d'$ are connected in shunt with the working circuit, the field being thus a constant one. Rheostats $i$ $i'$ are included in the field coil circuits for the purpose of regulation, the rheostat $i$ being preferably an inductive one.

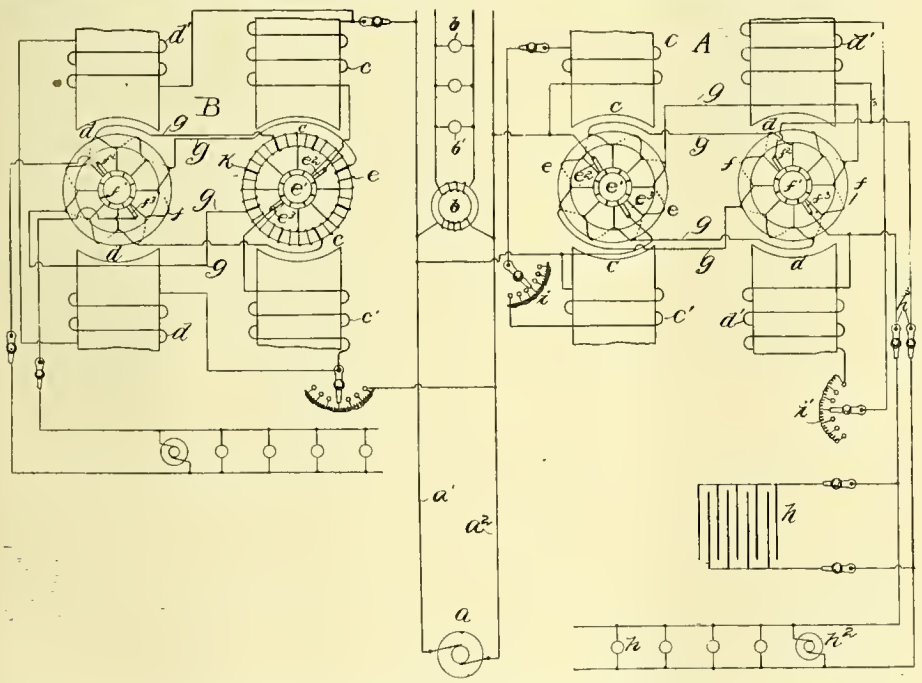


FIG. 1. ELECTRIC CONVERSION SYSTEM.

The alternating current traversing the main armature winding reacts upon the field $c$ to produce rotation, the motor-generator thus starting from rest. When normal speed has been attained the currents from the main winding periodically and successively traverse the coils of the supplemental winding in harmony with the alterations to produce biphase currents, and, in consequence, a rotary field, the biphase currents being then commutated, and a portion of the constant current thus produced traverses the field coils $d'$ to produce a magnetic field which reacts upon the rotary field to maintain synchronous rotation.

The motor-generator $B$ is of the series type, the field coils being connected in series with the armature, the supplemental field being in this case also excited by the alternating current, the field $d'$ being in consequence an alternating one instead of constant as in motor-generator $A$. The field coils of the two fields are shown connected in parallel, but they may be connected in series. A secondary winding $k$ is provided in addition to the winding $e$, being connected therewith only in inductive relation, the secondary winding being indicated by heavy lines, while the main winding is indicated by light lines. The secondary winding is connected with supplemental winding $f$ by means of conductors $g$ in the same manner as the main winding in motor-generator $A$.

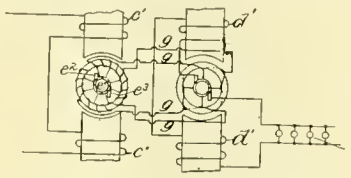


FIG. 2. ELECTRIC CONVERSION SYSTEM.

The working circuit containing the translating devices is connected with the brushes $f^2$ $f^3$. The motor-generator $B$ will thus be of the step-down type, since the main winding $e$ has more coils than the secondary winding $k$. Were the reverse the case it would be of the step-up type. The constant current supplied by motor-generator $B$ is in consequence of a less voltage than the alternating current.

In Fig. 2 is shown a motor-generator of the induction type, the main armature winding not being in electrical connection with the source of alternating currents, the currents traversing the same being produced wholly by induction. In this type a voltage upon the consumption circuit higher or lower than that upon the feeding circuit may be obtained by proper adjustment of the number of turns in the maint armature winding, no secondary armature winding, like that shown in motor-generator $B$, being necessary. The field coils $c'$ are traversed by the alternating current. A pair of short-circuiting brushes $e^2$ $e^3$ rest upon the commutator $e'$. The field coils $d'$ are connected with the consumption circuit in series, the motor-generator being thus self-regulating and maintaining a constant voltage upon the consumption circuit. If, for instance, the motor-generator is running with a certain load, that is, with a certain current flowing in the consumption circuit, and more lamps in parallel are cut in, thus decreasing the resistance of the circuit, more current will flow through the consumption circuit; but the decrease of external resistance causes a decrease of voltage at the brushes feeding the consumption circuit, and, further, an increased current flowing, the drop on the consumption circuit between the brushes and the translating devices is greater, so that the voltage to which the translating devices are subjected is decreased for these two causes, but the field coils $d'$ being in series with the consumption circuit, an increased current traverses the same, thus increasing the supplemental field strength, thereby inducing in the supplemental winding an electromotive force which is added to the voltage of the main winding to increase the voltage at the brushes and compensate for the drop caused by the decrease of resistance and increased current flow.

## Direct Current Motor and Dynamo Design.[1]

By Gano S. Dunn.

I wish to refer to-night to several features of direct current motor and generator design, and not to pretend to cover the whole subject, and I trust this will not be without interest to you.

The first point I wish to bring out is how very imperfect are our means of rating electrical machinery. We have good means of rating other machinery, but we do not have good means of rating electrical machinery. The steam engine is rated by the diameter of its cylinder and length of stroke and its speed. It is not sold by horse power, because an engine which could develop 100 horse power at $\frac{3}{10}$ cut-off would develop 200 horse power at $\frac{6}{10}$ cut-off. In electricity the problem is similar, but we have no way of rating motors by the diameter of cylinder and length of stroke as they have in steam engine practice, and we are continually suffering on this account. Water wheels are not sold by horse power. You do not buy a 50 horse power water wheel; you buy a 28 inch water wheel and run it at so many feet head, and then figure out how much power you can get from it, and if it is not enough you buy a 30 inch wheel.

The limits of loading an electric motor are really two only; namely, you have reached the load of a motor when it begins to heat so much that it is dangerous to continue to run it, and you have also reached its limit of load when it sparks so badly that if you run it longer it will destroy its commutator. There are builders to-day who build a motor which will have a very high efficiency at one-third load, but which will spark if it is overloaded, and there are other makers who build a machine which has not a high efficiency at light loads, but which will stand three and four times normal load without sparking. Now both of those motors are listed in the catalogues, are charged for and are known as, let us say, 10 horse power motors.

If you buy a 10 horse power motor without knowing something about these facts, it is possible that you will be very much mistaken. If it is agreed that we should call a motor that runs at about 6 horse power, but is capable of running at 10 horse power continuously without dangerous overheating, but will never be called upon for more than 10 horse power—if we should agree to call such a motor a 10 horse power motor, very well. But then we ought to call the motor which is used in crane service, which is called upon for 30 or 40 horse power for periods of ten minutes at intervals, something more than, or different from, 10 horse power, and the builder ought not to be obliged to make one motor fill one user's requirements and another user's requirements, when their requirements differ so much. Suppose we sell two 10 horse power motors to ordinary customers. We may hear a report from one of them that this motor is not a good motor; it does not give 85 per cent. efficiency at one-third load. While the other one will say this motor is not a good motor; it sparks very badly when loaded to 300 per cent. of its normal load for a few moments. In view of these facts horse power is not a fair way to rate machines.

The lines between these kinds of motors are not so distinctly drawn as I have pointed out, but for the purpose of illustration I have shown here two curves, $A$ and $B$, Fig. 1. $A$ is the curve of a motor of the kind first mentioned above. It is expected to run at 6 horse power average; can give 10 horse power all day long if you require it, but must not give any more, and has a very high efficiency at light loads. Such a motor is an ordinary power motor for running a printing or machine shop. The other motor, whose curve is shown at $B$, is a motor whose efficiency at light loads is very low; it is not much more than half of the former. But its efficiency at full load is exactly equal, and at overload is even higher than this other motor. Motor $B$ is much superior for its work to the former motor because whenever it does run it runs at three times its rated load, and motor $A$ whenever it runs, as I will show later, runs at only one-third its rated load. Put motor $B$ on the load that $A$ is built for, and $A$ on the load that $B$ is built for, which is what you are likely to do, and you will not secure the best results.

This $A$ curve machine is the type of ordinary power motor running machinery by a belt. The $B$ curve machine is a type of railway motor or motor for operating cranes, or for other intermittent and very heavy work. These two conditions affect the design of a motor very much, and the way they affect it is this: At the point $C$ both motors have the same efficiency. That means that the losses in both motors are equal. But why, then, does curve $A$ differ from $B$? The difference is in the distribution of the losses. The losses in a motor are of two kinds, fixed and variable. The fixed losses are the losses due to field current, hysteresis and eddy currents, brush friction and bearing friction. The variable losses are the losses due to armature resistance and the losses due to commutation. Now motor $A$ is a machine with a small magnetic circuit using comparatively few lines of force. Therefore the wire that is wound around this magnetic circuit to keep it excited need not be very great and therefore will take but a small amount of current to energize it. The iron in the armature will be small in quantity, and therefore the hysteresis and eddy currents will be low, and the bearings will be rather light because this motor is never called upon for more than rated load. Therefore the fixed losses are light. The variable losses, such as armature resistance and commutation losses, may be high in this machine without detriment. The reverse of these conditions is true in machine $B$. These points are of great importance, but they have not received attention.

As a result of tests made on about 200 power motors, at the instance of H. L. Lufkin of the Crocker-Wheeler company, it was found that these 200 motors on actual commercial circuits did not average one-third of their load. The readings were taken in this manner. It is customary wherever a

1. A lecture delivered before the New York Electrical society, November 27, 1894.

motor is installed, to put a meter that measures the current taken. Now if this were a 10 horse power motor and ran ten hours per day, it ought to have 100 horse power hours for every day it runs. The meter readings were taken and the average was between 25 and 30 per cent. of the power that the motor could have given according to what was stamped on its name plate. Now if we build a motor with the kind of an efficiency curve *B*, and use it for a purpose such as I have just spoken of, where a motor averages only one-third load, it is practically equivalent to taking a motor of only one-half the efficiency.

Another thing with regard to the rating of motors is the speed. Other things being equal a high speed motor is cheaper to build than a low speed one. It is a smaller machine operated at greater activity. If brought to the same

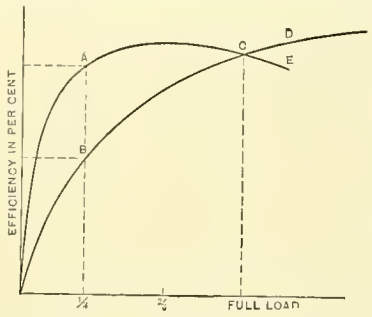



FIG. 1. DIRECT CURRENT MOTOR AND DYNAMO DESIGN.

speed it would have less power. A motor, to be compared carefully, ought to have these points determined:

1. At what portion of its load does it commence to spark?
2. At what portion of its load will its temperature rise abnormally?
3. What is its efficiency at various points?
4. At what speed does it run?

Reduce all these things to a common basis and you have a fair method of comparing motors.

Too much importance has heretofore been attached to full load efficiencies. Motor engineers boast that their machines have 90 per cent. efficiency and some other maker's machines have only 88 per cent. efficiency. They speak of the highest efficiency that the machine is capable of, or of the efficiency of which they are most proud. Now that may not be the efficiency which the customer wants to know. There are many cases where a motor of 85 per cent. efficiency would take less current to run a printing office than a motor of 90 per cent. efficiency, for this reason: At point *D*, Fig. 1, is a motor of 90 per cent. efficiency. But the printing office runs at only about one-third of the power of its motor, and would therefore realize the efficiency at *B*; whereas at point *E* here is a motor which has 85 per cent. efficiency and if the printer bought that he would realize the efficiency at *A*, which is much higher than that at *B*.

The next feature to which I wish to call your attention is the most recent methods of winding. I cannot go into this more than slightly, but it might be well to give some idea of what they are. In winding bipolar machines, windings are all on the same principle; they are two-circuit. As the current leaves the brush, in diagram *A*, Fig. 2,[1] half goes down one side of the armature and half down the other and joins the bottom brush and goes out. Now there is not much room for modifications in that winding. It can be made ring or drum, and that is practically all. But when we come to the multipolar machines there is a great variety of windings which we can use. If we imagine *B*, Fig. 2, to be a four-pole machine, with an armature a ring in which the wire is wound around and around, then the current may be taken off this armature by brushes *P*, *N*, *P*, *N*. These are the field magnets of alternate polarity and each field-magnet generates a portion of the total current. This is called four-circuit, because there are four circuits from which the current is collected in the armature.

The earliest multipolar machines were wound in this fashion, but there are some objections to it. If one pole is stronger than its neighbor, then when it sends its current to be collected it will be under greater pressure than the one coming from the other pole and if there is sufficient difference will neutralize it and send a reversed current through its winding. This causes heating, diminishes output and reduces the efficiency of the machine. Now it is very easy for one magnet to become weaker than another one in an actual machine. Suppose, for instance, that the bearings of the machine wear. The armature will settle down and will be nearer the bottom magnets than it will be to the top and they will make stronger currents than the top ones will. Then again, if the windings on the magnets are not very carefully made and one has a few more turns of wire than the other, it will be stronger, and there are a great many ways that the effect of inequality of electromotive forces generated under the poles will produce very bad results.

To overcome this, windings were invented which are called two-circuit windings. The object of the two-circuit winding is that the wire shown in *D*, Fig. 2, instead of going along always under the weak pole, between every section, cuts across and goes under a strong pole and comes back, and the winding under the strong pole cuts across every other section to the weak, so that by the time the brush is reached, the windings have each had acting upon them both the weak and strong poles and the result has been to make equal electromotive forces and produce no trouble.

In actual winding these connections are not made on the armature in this form of two-circuit winding, but are made inside the commutator. This commutator is of the kind shown in Fig. 3. Every bar is connected to the bar directly opposite to it by a bird-wing form of connector. The connector is shaped in the following way: It starts down, goes over in the form of a bird-wing, goes inside about an inch and after it has reached the under layer of windings it makes the rest of its circuit until it gets down to the bottom. The armature is wound the same as a four-circuit armature, but when its ends are put into the commutator, these cross connectors have the effect of making the alternate poles generate part of the electromotive force, as shown in the diagram. The armature I have described is but one kind of a two-circuit armature, but there are other kinds that are used just about as much. The other kind of armature is not wound in ring form but is like that shown at *E* in Fig. 2. Now the armature I have just described was wound as a coil, which was connected to another on the other side. There will be no short-circuiting due to unequal voltages. (A model of this kind of an armature was exhibited.) I will not describe farther the two-circuit windings, since they are all on the same principle.

There is another advantage in the two-circuit winding besides stopping the interaction of parts of the armature against itself; and that is, that for very high voltage machines if we had a four-circuit armature as previously described in *B*, Fig. 2, the wire under each pole would have to generate full voltage. In a 500 volt machine, each pole would have to generate 500 volts, so that the little current it contributed would be at the same pressure as the other current. That necessitates fine wire. If there are only two circuits each pole contributes only half the voltage and the wire may be of twice the size, which is a very important consideration. When we get into very large machines, however, then the wire gets too big for us to handle in two-circuit machines and we go back to the four-circuit windings.

The next form of winding that I wish to describe is one in use by the General Electric company and known as a double winding. The reason for a double winding is this: It is a rule among electricians that the voltage between any two bars of the commutator must not be greater than, say, 20 volts. If it is much greater in a large machine, any little accident—a piece of carbon—would make a flash, and, once started, the whole commutator would blaze and there would be a short-circuit and great trouble. To keep that down the voltage between the bars must be kept down low.

The voltage generated by a machine is proportional to the size of the magnets and the number of the windings. Now as the magnets get large the windings need be fewer in order to generate the same voltage. As our machines get larger and our magnets get larger we only need a few turns of the heavy conductors on the armature to give us, say, 110 volts for lighting. We soon reach the point where, say, 10 turns on the armature would be enough to give us 110 volts. That would give us 10 sections to our commutator, and as half the sections are on one side and half on the other, that would give us only five sections of the commutator among which to

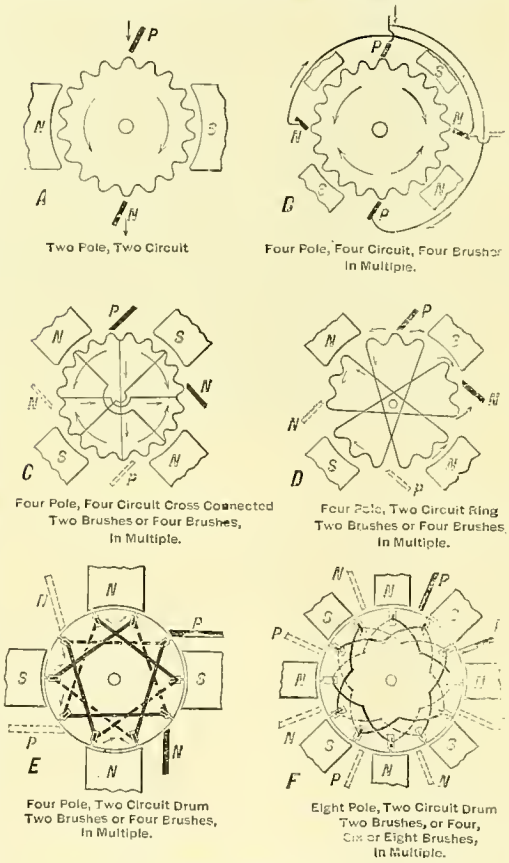



FIG. 2. DIRECT CURRENT MOTOR AND DYNAMO DESIGN.

distribute 110 volts, and that would be more than our limit. Now what are we to do? We cannot increase the number of turns because we would get more voltage than we wanted. We cannot decrease the size of the magnets because then we would have sparking and armature reaction and other troubles. There are two things for us to do: one is to use the multipolar machines, which have a number of small magnets each contributing to the total current, or to use the form of winding shown in Fig. 4. Now in this diagram there are 10 coils and 10 commutator bars belonging to each winding. When we use the windings in conjunction we have the voltage due to 10 coils and the commutator bars due to 20, and that is achieved in this manner: The windings are wound just as if they belonged to two different machines. One winding is entirely disconnected from the other and it generates, say, its 110 volts with its few commutator bars—too few to be used by itself. The other winding is entirely separate and it generates its 110 volts with few commutator bars—too few to be used by itself. But when we put these two windings together, then we have still 110 volts, but we have double the current, because each of the windings contributes some, and we have double the number of commutator bars. Now that is in reality just like two dynamos. The brushes are made so wide that they cover at least two of the commutator bars, so that each winding is free to contribute its share of the current, no matter what the position of the armature is. We have shown this for a bipolar machine. But if we go into multipolar machines we will soon reach a size where we are again face to face with it, and we would have to increase our poles and would soon catch up with this difficulty again, and this method of double winding is an excellent one for overcoming it. It has also the advantage that the collection at the brush is better.

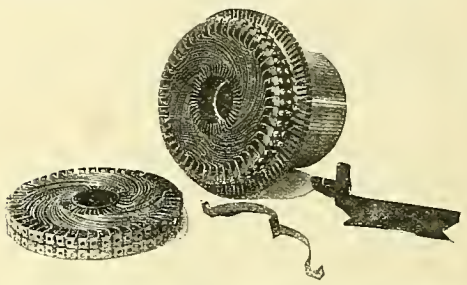


FIG. 3. DIRECT CURRENT MOTOR AND DYNAMO DESIGN.

The next feature I wish to speak about is sparking and armature reaction. Sparking is the phenomenon of sparks at the brushes of a direct current machine due to the self-induction of the coils. There are a number of forms of sparking which are not due to that at all. If this commutator were full of ridges it would spark, but those can be easily turned off. If the brushes are too small it will spark, but they can be made larger. These are not inherent difficulties; they are merely matters of construction. But if we construct these at our best, we will always have the sparking, which I have just defined, due to the self-induction of the coils. The reason for that you are familiar with. It is shown in the diagram, Fig. 5. It is at the moment of change of the direction of the current that we get the spark, the same as we do in an induction coil when we start or stop a current in it; and this coil has a certain amount of electrical inertia that will not submit to being reversed suddenly. It has got to take a little time and the spark shows. Now a large portion of the design of direct current machinery is nothing else than provision that the machines shall not spark. There are two methods by which we can stop the sparking. The first method is by forced commutation. The second method is by means of an electromotive force applied to the coil which is at the moment having its current changed. This electromotive force helps it to change quickly. Forced commutation is the means of killing the spark by resistance of brushes. The coil *A*, Fig. 5, has no current in it. But as the armature is revolved pretty soon the toe of the brush will leave the commutator bar *b*. Then the brush will bear only upon the commutator bar *c*. Thus, half the current will be obliged to go through the coil *A* in order to get through that half of the winding marked *L*, and the other half will come down to *R* as usual. Now if that coil *A* can be prepared so that when its turn comes to take its place with the rest of the winding it can have the current already flowing in it of the same quantity as the current in its new position, then on leaving the toe of the brush, at that bar *b* there will be no sparking. Now that can be done in forced commutation by having the resistance of the brush sufficiently high. As the commutator moves and the brush touches less and less of the bar *b*, the current finds it harder to get into this commutator bar than into *c*, so it begins to overcome the electrical inertia and go up the coil *A* gradually from *c*. By the time *b* has moved from under the brush the whole current will have been gradually throttled to go out of bar *b* and forced to go up into the coil *A* and there will be no sparking.

To put carbon on some machines is very bad, because it has so very much higher resistance than copper that it uses up the power of the machine, and therefore other materials have been very much sought for. The copper brush is made with many laminæ so that the current that comes down through the brush cannot all get squeezed into that little toe. It cannot get into that toe unless it is started into it at the top of the brush, and if it is started into it at the top there is an appreciable resistance. If that resistance is not enough we resort to the copper gauze brush, which has a much higher resistance than a copper leaf brush, and while there are some mechanical advantages in using it, such as cooling effects, yet the principal reason it stops sparking is that it has higher resistance. If this is not high resistance enough we go the next step, which is a brass gauze brush, having about twice the resistance of copper gauze. If that is not enough we take the next step—that is, some form of carbon which has its resistance reduced. Ordinary carbon cannot have its resistance reduced. But all sorts of inventions have been made, such as putting fine filings in the brush, and in this case the brushes are made with layers of gauze molded in them, so that the gauze helps to increase the conductivity of the brush. After that comes the pure carbon, and if that is not of high enough resistance it can be made as high as desired by mixing clay with it. The resistance of brushes ought to go up as the voltage of the machine goes up. I have had in mind, but have not had the time to carry them out, experiments to determine just what the law is. I believe it should go up as the square of the voltage, and that by making our machines on that basis and considering the resistance of the brushes just as much a part of the design as we do the resistance of the armature windings, we could build very large machines of very high voltage without sparking. I do not see why the resistances could not be just right so as to squeeze all of a 10,000 volt current over into the bar following before the break takes place.

1 From "The Practical Management of Dynamos and Motors," by F. B. Crocker and S. S. Wheeler.

In connection with this there is one thing that we have forgotten. If we do that squeezing and throttling, it heats the commutator and if the commutator is too small its temperature rises. It decomposes the carbon brush; it gets black and the machine is rendered unfit for use. If you are going to determine on forced commutation you must then have a definite ratio of commutator surface for every horse power in your machine. That is as true as the fact that the resistance of your brushes should go up with your voltage.

So much for forced commutation. The other method of stopping sparking is by applying an electromotive force to the coil *A*, just as it comes out of circuit, so that by the time it comes into circuit it shall have its current. Applying electromotive force means that you have a little dynamo working to get up the current so as to have it ready. Now that electromotive force will be applied by the magnet held in my hand and I will endeavor to show you how it will

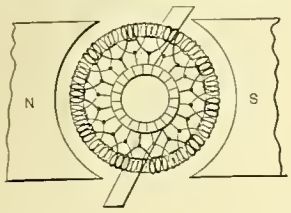



FIG. 4. DIRECT CURRENT MOTOR AND DYNAMO DESIGN.

work. (Mr. Dunn started the machine.) This is an armature which has not any field acting on it at all. It seems to me that sparking can be understood better if we talk about it entirely separated from the field magnets. So I have an armature here which is simply revolving in the air. Now I am going to pass its normal current through it and will show you that it sparks. This has not forced commutation because it is a copper brush. Neither is it prevented from sparking by the electromotive force, because there is none acting upon it. To spark is the normal, natural condition of the armature. I have here a carbon brush which will stop the sparking by virtue of its resistance and will be an example of forced commutation. You see the sparking is killed by virtue of the resistance of the carbon brush.

Now I will show a method of killing the spark on this copper brush by means of the electromotive force applied.

I have here a magnet, Fig. 6, which is energized from the circuit and which will throw out a few lines of force. I will apply it to the armature in the region of the brush and you will see the sparking disappear. (The armature, Fig. 6, is supposed to be driven by another motor.) It may happen that the polarity of this is wrong when I put it on and it may make the current in the coil go the wrong way, so that when it is thrown into circuit it will have to stop the current that is flowing wrongly and then start a proper current and the sparking will be increased. The polarity is right and you see the sparking disappears.

Now I am going to give this not quite enough electromotive force to bring its current equal to the current in the rest of the armature. I will do that by moving the coil a little to one side. The sparking appears again. Now I am going to give it too much, so that the current generated in the coil under the brush is too big for the rest of the circuit. Now it is equal to it, and there is no sparking; now it is too big, and the sparking appears again.

Sometimes it happens that an armature with brushes at the neutral point sparks worse than it would if it were let alone. This is because the magnetism from the opposite pole comes over and increases the spark. It is drawn over apparently by the revolution of the armature. That condition can be imitated by reversing the polarity in this coil. I will first reduce the sparking to zero by this electromotive force. Now I will reverse the direction in the coil. The effect is vicious sparking.

You have seen how an electromotive force will stop sparking, and you have also seen how resistance in the brush will also do it. Now the commutation of every machine that is built takes place by means of one or the other or a combination of these devices. The larger the machine the more difficult it is to adopt forced commutation, because the excessive heating of the brushes causes the commutator to overheat. To design a dynamo so that it will not spark—a

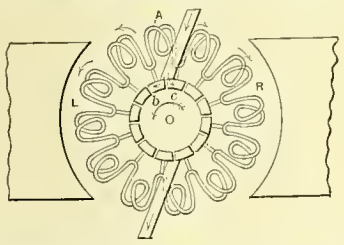



FIG. 5. DIRECT CURRENT MOTOR AND DYNAMO DESIGN.

dynamo of any size—is merely so laying out its magnetism that it will always get a little squirt of lines of force right in the brush. Now you see me moving this coil toward its brush to stop the sparking. But what you do in an actual case—you cannot move the magnets or you cannot move a little coil like this—is to move the brush so that it comes under the edge of the big magnet of the machine and that accomplishes the same result. That is why shifting brushes stops sparking. It enables you to get a little fringe of magnetism which trails off the toes, and does the same thing that you saw this little coil do.

There are reactions that oppose the coil and there are also reactions that oppose this action at the toe of the machine. Before you shift brushes you may have a fringe of magnetism that would stop the sparking if it could get at it. But by the time the brush is moved toward it that motion of the brush has induced reactions into the circuit which have driven back the magnetism. A very important point in dynamo designing is the providing that magnetism shall not be driven away. To show you one of the reactions that tend to drive away that magnetism the next experiment is arranged.

Here is a motor that would normally run forward. As you see, it has no field coils on it, so any magnetism that it may get to run it will have to come from the armature. Now, as I said, it would naturally run forward if it were working with the magnetism generated by its field. Now I will put the armature current alone through it—its regular current that it would have ordinarily—and you will see how it runs. You see it runs backward. That is what the armature would do if it could in any motor. The fields have to be strong enough to overcome that tendency, and besides overcoming it to give sufficient magnetism to make the armature go forward. That is one of the things that destroys whatever little fringe we have to reverse our coils and prevent sparking. The machine is now running simply on the reaction field produced by the armature. There are no coils on the machine. This reaction is due to the negative ampere turns of the armature. It is easily calculable, and what we have to do is to make the magnetism that comes up this magnet of such strength that it goes through the big air gap, offering so much resistance to it that the little extra resistance offered by that reaction on the armature amounts to nothing in comparison and so that when the armature offers this resistance we still have our little fringe of lines of force which act as the little coil did to stop the sparking.

In a motor we shift the brushes back to stop sparking because the proper polarity of fringe comes out of one pole, and in a dynamo we shift the brushes forward to stop sparking because the proper fringe comes out of the other pole.

A method of increasing the resistance of the air gap is, in the toothed armatures, to make the teeth very narrow. Here is a toothed armature of a four-pole machine. All the magnetism that gets into this armature has to get into it through these teeth under about 70 degrees of pole piece. You can see that the sum of these teeth is not enough to carry all the magnetism that would go through that core. The result is that the magnetism is squeezed so hard that the reaction of the armature does not amount to much. This effect that I showed of a motor running backward will do the same thing as the winding attributed to both Ayrton and Perry and Sprague will do. If the conditions are right we could have a motor, even with fields on it, such that its reaction will be such in proportion to the effect of these fields, that while the armature will not run backward when

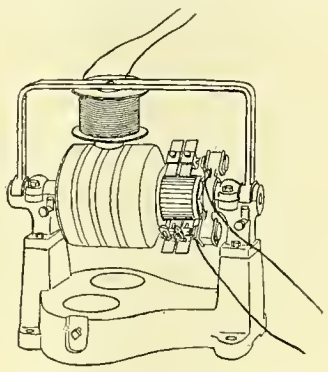


FIG. 6. DIRECT CURRENT MOTOR AND DYNAMO DESIGN.

the load comes on, yet it will so weaken the field magnets that the armature speed will increase. I have known instances of this, and it can be secured by a little proportioning of the armature, very easily and without any other winding. All the benefits, whatever they are, of the winding of Ayrton and Perry and of Sprague could have been secured by proportioning their armatures without going through the expense and trouble and elaborate calculations of the differential motor winding.

One more feature that I wish to call your attention relates to compound winding of dynamos. That problem is a serious one and is more so than it used to be. A compound wound machine, as you all know, is a machine which, when the load comes on, instead of having its pressure fall off a little, as everything does—steam engines, water wheels all slow up and pull down a little bit when the load comes on—will have its pressure rise a little. This rise is for the purpose of compensating for loss of pressure in the line. Now if you are lighting a number of lights at a distant point, and when you have all your lights burning let us assume that you get 10 per cent. less pressure at your lights than you would if you had only one of them burning, a compound wound dynamo can be made so that as fast as the pressure falls, due to—call it friction of the current in the wire—the dynamo increases its pressure to make up for that, with the result that your lights have always a constant pressure. The voltage at your dynamo rises but your lights are constant. We ought to have this so that at half load the increase of potential would be half of the increase that we have allowed for, and with three-quarters it would be three-quarters, and at full load it would be the full increase. That is impossible to attain exactly.

The rise of voltage must be obtained by increasing the magnetism of the machine as the load increases. Suppose we want an increase of 10 per cent. in voltage. If we start at *C*, Fig. 7, we can increase the magnetism and at *D* will have 10 per cent more magnetism than at *C*. But notice at what a sacrifice we have had to more than double the magnetizing force. Not only does that reduce efficiency, but it means double the amount of copper. But the curve from *C* to *D* is straight and at half load we get half the increase of potential and at full load a full increase.

If I should work in the region between *B* and *C*, then at half load we would get a good deal more than half the increase of potential wanted. So we cannot work on that part of the curve; that would injure the lights. Now if we work down on the point of the curve where it is straight again, from *A* to *B*, we secure the results of an even increase of potential. But here we have a machine which we are working at a saturation *B* and all the capacity from *B* to *C* is wasted. In other words, we have to use considerably more iron in that machine in order to saturate the iron at so low a degree as will allow its curve to be straight, and that makes the machine much more expensive and less efficient, because we have copper wire around that iron which gives rise to a great many disadvantages. Now I have devised a method for enabling this portion of the curve *B* to *C* to be used with a straight rise of potential. The custom of builders is shown in Fig. 8. One engineer will specify that he wants a 2 per cent., another a 3 per cent., another a 4 per cent., another a 7½ per cent. increase of potential. The manufacturer cannot meet all those demands, so he winds every machine for, say, 10 per cent. increase of potential, and Fig. 8 represents a machine so wound. The coils *B* are the

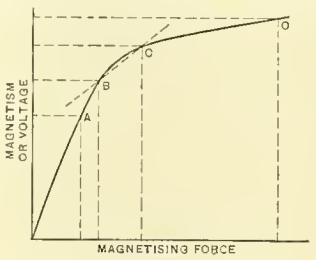



FIG. 7. DIRECT CURRENT MOTOR AND DYNAMO DESIGN.

shunt winding. The coils *A* are the series winding. The current as it comes out of the armature goes in around the series windings and then out to be used. It will be seen that at no load the series coil is not excited at all, while at full load it gets a good many amperes through it, and that increases the magnetism enough to make up for losses and raises the potential. If this machine is wound for 10 per cent. over-compounding and a user orders 5 per cent. over-compounding, it is the custom of the manufacturer to insert a shunt *S*. Whereas the whole current would, previous to the addition of the shunt, have gone through the coils *A* and out and given 10 per cent. increase, now the current divides equally between the coil and shunt and gives only 5 per cent. increase in the magnetism. It has been customary to make this shunt of some material whose resistance is fixed, so that if a user ordered 5 per cent. he would get a 5 per cent. distribution at all times and it was considered bad to have this changed. The shunt was also made very large to keep it cool. By making this shunt, not of German silver, as is customary, but of iron, which has a very high temperature coefficient, and then, instead of making it large, making it very small, so that a small amount of energy will heat it up and change its resistance as much as possible, we can at full load throw into the series coils a good deal more than the proportion they would get at light load. That extra current, if the increase of magnetism were proportional to increase of magnetizing force, would tend to make the increase of potential follow a curve convex downward. Now the increase of magnetism tends to follow a curve whose convexity is upward and the shunt tends to go up, so the result is the potential rises along a resultant of these two which can be made a straight line. But there is this proviso—you must wait for the shunt to get hot. If you put a sudden load on the machine for five seconds and then take it off again, the rise of potential will follow the straight line. We could inclose the shunt in a vacuum so that it would reach its temperature in half a minute. If the generator were for lighting, the load would not change suddenly and therefore the increase of potential could be counted on to be practically proportional.

## Extension of the Metropolitan Assured.

Commissioner of Public Works McCarthy has issued a permit to the Metropolitan West Side Elevated Railroad company, Chicago, for an extension of its line on the Humboldt Park branch. The permit allows the extension of the work between Wabansia and North avenues, from Kedzie

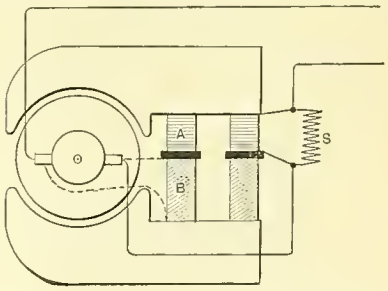



FIG. 8. DIRECT CURRENT MOTOR AND DYNAMO DESIGN.

avenue west to the Milwaukee and St. Paul railroad tracks, between Hamlin and Lawndale avenues.

## Wisconsin Electric Club.

At the annual meeting of the Wisconsin Electric club on the evening of December 7th the following named officers were elected: President, Thomas R. Mercein; vice-presidents, John D. McLeod, Prof. A. J. Rogers, George H. Benzenberg, D. J. Whittemore and Prof. W. S. Johnson; secretary, Walter Smith; treasurer, W. H. Hyde; board of managers, O. M. Rau, L. Jansen, John E. Wiles, T. F. Grover and S. A. Barclay.

Western Electrician.

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CORRESPONDENCE relating to electricity or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THE announcement of the death of Fred E. Degenhardt came with such startling suddenness to the electrical fraternity of Chicago that it is yet difficult to realize that he has in truth passed away. Young and vigorous, active and cheery, it seems impossible that Fred Degenhardt can be dead. Yet he has gone. He presented the combination, rare in electrical circles, of a practical inventor and a keen business man, and was withal a true man and a loyal friend. His presence was a welcome addition to any business or social gathering; he had many friends and few enemies. He will be sorely missed.

ELECTRICITY is gradually gaining a foothold in mining operations in Germany. Recently several applications were made, and in each instance the result of the experiment has been satisfactory. The advances that have been made in this country have been so great during the last few years that mining engineers have long ceased to look upon the electric motor as a novelty. Complete systems of electrically operated mining machinery are now in competition with other forms of mining machinery, and the electrical apparatus has shown so many advantages that it is rapidly growing in favor.

AN exceedingly interesting paper is presented in this issue on "Direct Current Motor and Dynamo Design" by Gano S. Dunn. The paper was read before the New York Electrical Society a few weeks ago and attracted considerable attention. Mr. Tesla, who was among those who heard the paper read, complimented the author upon his work, which showed evidence of thoroughness and familiarity with detail that could only be gained by close application and considerable experimental work. The society is to be congratulated, too, upon the standard it has established in the beginning of the season's work, and it should be its aim to keep up to that point at least in all future work.

AN overhead trolley line for London! Well, well! Pretty soon they will be running an electric elevator to the dome of St. Paul's. It seems hardly credible that there should be every probability that an electric railway on the overhead trolley system will soon be in operation within the Metropolitan District of London, and yet we have the authority of a reputable English technical journal for the statement, as will be seen by the reprinted article on another page. It is rather difficult to comprehend the intricacies of municipal control in London, but we are assured that the London United Tramways company's plans for electric traction have been unanimously approved by the Hammersmith Vestry; that the company has obtained parliamentary powers for the electrical equipment of the lines, and that the London County Council will probably make no serious objection. The overhead construction will be of the latest pattern, and steel poles will be used. Friends of electric traction the world over will be delighted with the prospect.

INTEREST in the project for a down-town loop to be used by all the elevated railways of Chicago has been stimulated by the presence in Chicago this week of several eastern capitalists who are interested in the Metropolitan and Alley "L" roads. Mr. Yerkes managed to be out of town when they reached the city, however, and another delay was experienced in getting a final settlement of the problem. There are many interesting points to be decided before the loop is built. It is conceded, of course, that the trains will be electrically operated, otherwise permission will not be granted for its construction. The Metropolitan will be electrically equipped, as will also the Northwestern, should it be built. But the Alley "L" and Lake street roads are now operated as steam lines, but both are losing money and a change to electric power may expected at any time. There is much gossip in the financial columns of the daily papers on this point, most of it favorable to the project. The *Chicago Evening Journal* on Monday said: "The Alley 'L' road could be put on a paying basis by electrical equipment, a northern extension to Adams or a southern extension to the Stock Yards and Englewood. Operators generally consider its future as great in possibilities. Its stock is the favorite speculative security and completely overshadows the rest of the market. At the annual meeting in January the control will be discovered. If the union loop is constructed it will be hard to convince some people that C. T. Yerkes does not now own controlling interest in all 'L' systems." Should a loop be established it is believed that all of the elevated roads will at once adopt electrical equipment.

ELECTRIC railway companies using the overhead trolley system are in business, of course, to make money. But it is a gratifying corollary, resulting from the very nature of their enterprises, that they are enabled to be a great benefit to the communities in which they operate. This fact is very often overlooked by municipal authorities, who are apt to dwell unduly on the companies' natural desire for profit, neglecting entirely the more important feature of the situation—the great advantage in large cities, particularly to the poorer people, of clean, healthful rapid transit by a system so economical that it can be extended to comparatively sparsely settled outlying districts. However, the world advances, and it is encouraging to observe that the benefits of the overhead trolley system in this larger sense are becoming appreciated in a constantly increasing degree, particularly in large cities, which have heretofore distinguished themselves, in most cases, as centers of dogmatic opposition. More and more the sentiment is coming to be: "The trolley railway is proving an excellent system for our town; let us therefore commend it and rejoice in the success of those to whom we are indebted for its advantages." And this fair-minded recognition need not, and in fact does not, prevent the people from holding the companies to a strict accountability for the privileges and franchises which they have obtained.

A pleasing exemplification of the existence of this sentiment in relation to the electric railway question in large cities is seen in a recent issue of the *Philadelphia Record*, which, in commenting on the report of the president of the Philadelphia Traction company, says: "But the success of the trolley is, of course, vastly more than a company concern. While the trolley means more earnings for the Traction stockholders, it means also vastly more money in the pockets of the people in innumerable ways; and not least in reduced suburban fares and in the saving of time for the whole community, which saving will be still more apparent on sleety days of winter. In truth, the benefits of the new system are mutual; and not for five times its cost of installation would Philadelphia be willing to abandon it and go back to the obsolete horse cars." That expresses the situation fairly and in admirable spirit. It will not be long before this opinion will be echoed by the press and public of Chicago, first, and then of New York. The triumph of the overhead trolley system will then be complete.

IN discussing the subject of "Electro-metallurgy of Gold and Silver," Mr. Eltonhead in his paper before the Engineers' Club of Philadelphia pointed out several advantages which this method had under favorable conditions over other processes. These may be summarized as cleanliness, quickness of action, cheapness, and large saving in cyanide of potassium by regeneration; not wasting the solutions, larger recovery of the gold and silver from the solutions; the cost of recovery less; the loss of gold, silver and cyanide of potassium reduced to a minimum; the use of caustic alkalies in such quantity as may be desired to keep the cyanide solution from being destroyed by the acidity of the pulp, and also sometimes to give warmth, as a warm cyanide solution will dissolve gold and silver quicker than a cold one. These caustic alkalies do not interfere or prevent the perfect precipitation of the metals. The bullion recovered in this process is very fine, while the zinc-precipitated bullion is only about 700 fine. In view of these facts it is not to be wondered that Mr. Eltonhead confidently anticipates the general adoption of the electro-chemical process as the cheap method of the future. In the method described in his paper, which is reproduced elsewhere in this issue, the ideas of Sir Humphrey Davy and John Wright have been utilized to a certain extent in making sodium and potassium amalgams by the electric current and dissolving metals with the cyanides; but the construction of the precipitating box illustrated, which is used in the described process, whereby the gold and silver only may be extracted perfectly from an old plating solution of cyanide, or from a cyanide solution leached from gold and silver ores, is claimed to be new. There have been many and important advances made in electro-metallurgy of late years, and modern mechanical devices have brought down the cost of the plant and treatment until, as pointed out by Mr. Eltonhead, the possibilities of the system seem to be unlimited.

THE recent advances that have been made by gas companies in securing the introduction of "incandescent gas burners" in business houses and public halls have greatly encouraged the gas companies and in some instances have given central station managers some uneasiness. It is not believed, however, that the new form of gas burner will stand the test of time. It is an old story, and there is no reason to believe that in the present case there will be any departure from the line followed by former attempts that have invariably failed.

In a paper on this topic Mr. Bain this week points out that there are two distinct fields for gas and electricity. They are not competitors and cannot be any more than kerosene or the tallow dip can be a rival of gas. Electricity for illuminating purposes is so far superior to all other forms and methods of illumination that no comparison can be drawn. But aside from the superior quality of the light there are many reasons why gas cannot gain supremacy as an illuminant. The heat from gas burners, especially the form under consideration, is so great that they cannot be used during the summer months. It is a fact, too, that those who have had occasion to work by this light complain that it seriously affects their eyes. It is certainly a most peculiar light and objects illuminated by it take on a greenish-yellow tinge that is not in the least attractive. For this reason alone it will not be popular among women, and persons having nicely furnished homes will discover without much assistance that this "economical" light destroys the harmony of coloring and pleasing effects in the furnishings and fittings of their homes that have cost them so much thought and care to devise and accomplish.

These objections against the light for residences are emphasized in other cases. For instances, in dry goods, millinery, clothing or furnishing goods houses it would be impossible to depend upon this form of illumination, for the reason that it would be impossible to distinguish different shades, and the advantages and beauty of combinations of colors and tones disappear as soon as this light is turned upon them. One peculiar effect of this light was forcibly illustrated in a Chicago barber shop last week where the new burners had been introduced. Half a dozen chairs in a row were occupied and the appearance of the half dozen upturned faces was strongly suggestive of the morgue, so much so in fact that it was remarked by patrons of the establishment.

It may be that the new burner will continue popular with certain classes for a time, assisted no doubt by the fact that people have not entirely recovered from the effects of the recent business depression and are keeping their expenses down to the lowest notch possible, but it is not to be expected that those who have once enjoyed the benefits of electric illumination will ever be satisfied to return to gas.

## Death of Fred E. Degenhardt.

Fred E. Degenhardt, western manager of the Standard Underground Cable company, died at his residence, 106 Seeley street, Chicago, on Friday, December 7th. Mr. Degenhardt's illness had been only of a few days' duration and very few of his friends knew of it until the announcement of the fatal termination was made. On Sunday, December 2d, Mr. Degenhardt contracted a cold which developed into pneumonia. Other complications followed, and the physicians in attendance diagnosed the case as one of appendicitis. The patient grew worse rapidly, and it was realized that there was little hope of recovery. As a last resort it was determined to perform the usual operation, but when this had been done it was found that the patient had a well developed case of peritonitis. Mr. Degenhardt did not rally after the operation. He had anticipated that his end was at hand and had bidden farewell to his wife and children before submitting to the operation. Throughout the trying ordeal he bore up manfully and before his death gave the necessary directions for the disposition of his affairs.

The funeral services were held at the family residence on Monday last and were largely attended by Mr. Degenhardt's former associates in the electrical business. There were many beautiful floral offerings and numerous expressions of sympathy and regret were received by the family from friends who had been unable to be present.

FRED E. DEGENHARDT.

Fred E. Degenhardt had lived in Chicago all his life and was one of the best known figures in electrical circles in the West. He was born in this city in 1856 and received his early education at Dyrenforth's college, which, "before the fire," was one of the best known educational institutions in the West. On completing his education Mr. Degenhardt engaged in making surgical instruments with his father, Charles Degenhardt, one of the oldest settlers in the city. Later he became interested in electrical work. He was appointed superintendent of the Northwestern Electric Light company, Chicago, and afterward was made general manager. He was identified with this company for six and a half years and then resigned to take a position with the Western Electric company, Chicago, as contracting agent. About nine years ago he became connected with the Standard Underground Cable company of Pittsburg and continued with that concern up to time of his death. He was western manager of the company, with headquarters at Chicago, and his territory included everything west of the Alleghany Mountains. He understood the cable business thoroughly and invented several devices and improvements in underground work. His familiarty with the details of the business was of great help to him. He was eminently successful as a salesman and was considered one of the best in the electrical business. But Mr. Degenhardt was not entirely occupied with the commercial side of the business. He devised an underground conduit system for street railways, which attracted considerable attention. This invention was fully described and illustrated in the WESTERN ELECTRICIAN of June 13, 1891. It was never exploited, however, as Mr. Degenhardt desired to make several improvements in details of construction and operation before placing it on the market. He was engaged in completing these improvements at the time of his death. There were many new ideas and novel features in this system, which indicated that much might be expected from Mr. Degenhardt in this line.

Many visitors to the World's Fair had the pleasure of riding in an electrically propelled chair, which was the joint invention of Messrs. Degenhardt and Keller. This vehicle was one of several styles and sizes devised by them and built by the Electric Perambulator company. This chair was illustrated in the WESTERN ELECTRICIAN of January 7, 1893.

Mr. Degenhardt was a member of several organizations, and during the life of the Chicago Electric club he was a moving spirit. He was chairman of the board of managers during the most successful period of the club's history and he contributed largely to the success of the organization both as a social and scientific body. He contributed several interesting papers to the club, which attracted considerable attention and called out an interesting discussion.

His home life was happy and he was devoted to his family. In 1885 Mr. Degenhardt married Miss Emily C. Lockwood of Tarrytown, N. Y., who with two children survives him.

## Analysis of Electrolyzed Water Pipes.[1]

By JOSEPH RIGGE.

When a few weeks ago you requested me to analyze some electrolyzed scraps of pipes which had been badly corroded under the action of the electric trolley current, I had no idea of the extent of damage done water pipes, gas pipes and telephone cables. I determined, however, to give the subject all the attention at my command, and have come to the conclusion that we are confronted with a new destroyer of our service pipes, which demands immediate attention and an efficient remedy. In the hopes of perhaps making a useful suggestion, I submit this analysis to your consideration.

I. The state of the case.

The difficulty does not arise from the alternating lighting plant, but from the direct railway motor system, in which the current leaves the generating dynamos at the power house and by means of feeders is distributed to the trolley lines, carried down the trolley arm to the car motors, where it does its work; then escapes by the wheels to the rails, by which it is expected to return to the generators. This would be the case if the rails presented the best home conductor, for electricity will always follow the path of least resistance. But the rails offer so much resistance at the joints, that the current naturally passes through the damp earth to the water, gas or cable pipes in the vicinity, and runs along these good metallic conductors until the rails again present an easier return to the home station. Where it leaves the pipes to pass back to the rails, the current keeps eating away the pipes, carrying away with it these minute particles of metal. In a short time little holes mark the places where the electricity escapes. These grow larger and corrode the pipe, giving it the appearance of being "pock-marked." The fact of the rapid corrosion of our underground iron and lead pipes along the route of the electric trolley cars is undeniable. In proof I refer to the ends of broken pipes in the office of our Board of Public Works. That electricity is jumping the rails to water and gas pipes and back to the track was abundantly evidenced by the volt and ammeter tests made by a party of competent electricians, to which the writer was kindly invited, on May 11th, last.

At the Nicholas street power house the difference of the potential of the water pipe over the rails where they entered the station was from 3¼ to 6 volts, and the quantity going to waste 30 amperes, making No. 18 wire so hot that it could not be held in the hand, and driving a ⅛ horse power motor attached to the water plug. At the Custom House, on Sixteenth and Dodge streets, enough current is leaving the street car rails for the water pipes and the moist foundation to corrode them before the building will be finished, and to fire the neighboring buildings. Even on Capitol Hill, where the ground is dry, a current of from 4 to 9 amperes, at a voltage of from 1¾ to 3½, works its way from the terminal rail to the water plug.

In some instances of pipe corrosion a spot of greater or less extent is singled out by the current and weakened until it becomes detached like a chip. These electrolyzed nodules are extremely light. Four samples examined by me gave a specific gravity of 2.36, 2.06, 1.88, 1.54; the latter resemble coke in weight and appearance. Bearing in mind that the specific gravity of cast-iron is 7.00, we may naturally inquire what has become of the iron? and what changes have taken place? This question was referred to me for solution. In order to follow the most rational method, it occurred to me to subject these nodules to the same electrolytic action which they had undergone.

II. The analysis.

We have under our streets an extensive plating battery in constant operation, of which the water pipes are presumed, in our case, to be positive, the rails negative and the intervening moist earth the solution. Wherever there is a difference of potential, that is, wherever the water pipes carry a stronger current than the rails, the electricity will flow from the higher to the lower, from the positive to the negative metal, through a conducting medium, carrying metal from the higher potential toward the lower, either depositing it on to the negative pole or dropping it on the way. Acting on this underlying principle of electrolysis a nodule previously weighed was attached to the positive pole of the trolley circuit, after the current had done its work, suspended in dilute hydrochloric acid, while at a distance of a few inches was the negative pole, consisting of a platinum plate connected with the water pipe. On closing the circuit a flow of electricity could be seen passing from the iron nodule through the solution toward the negative platinum, carrying with it into the solution particles of iron, as could be seen by the decomposition of the solution into hydrogen and chlorine, the hydrogen escaping by the negative pole and chlorine combining with the free iron to form iron chloride. The liquid was occasionally renewed and tested for iron, till after five days it gave no further reaction with sulphocyanide of potassium, thus indicating that the nodule had no more iron to give. After drying, it was weighed. The loss of weight was, iron, 56 per cent. Now, if the piece of electrolyzed iron had lost all its iron, the solution of iron chloride had gained, and therefore should contain as much. This was actually the result, titration by potassium bichromate being the method employed.

The nodule deprived of its iron retained is former shape, but was extremely light and frail. It was, in fact, but the ghost of its former self. Was it carbon? Analysis gave 29 per cent. graphite, 13.37 silica and 1.15 manganese, with traces of sulphur and phosphorus; hence the complete analysis of the electrolyzed pieces of cast iron pipe would be:

| | | |
|---|---|---|
| Iron | 56.17 | Specific grav., 1.88 |
| Graphite | 29.00 | |
| Manganese | 1.15 | |
| Silica | 13.37 | |
| Sulphur, phos. | | |
| Total | 99.71 | |

Compare with this the composition of a fair sample of (gray) cast iron:

| | | |
|---|---|---|
| Iron | 90.58 | Specific grav., 7.00 |
| Uncomb'd carbon graphite. | 3.70 | |
| Silica | 4.14 | |
| Manganese | 0.83 | |
| Sulphur, phos. | small | |
| Total | 99.25 | |

We can now readily understand how, under the action of electrolysis, our city service pipes have much of the iron, their backbone of strength, corroded away, leaving behind in its place a frail shell of graphite iron, incapable of sustaining even the ordinary pressure of the mains.

That the above results appear to be warranted is confirmed by an analysis of the earth around the electrolyzed parts. Several samples of earth were found to have gained as much iron as the pipe had lost.

It should be borne in mind that the above analysis is not intended to be a representative one of all similar spots of corrosion. Three other samples examined gave varying percentages of iron and graphite, one being so very light, unctuous to the touch, incombustible, and of such greying black metallic luster that I would almost call it pure graphite. It was a good conductor of electricity, burned like the carbon of an electric lamp, marked paper like a soft lead pencil, and coated a platinum dish with the unctuous black of stove polish. All the other samples marked paper like black lead, and had more or less of the preceding proportions.

But the question, Where does the excess of carbon come from? is not so easy of solution. The fact that the photographs of the corroded pipes in the city engineer's office are corroded in particular places may be owing to defects in the casting, for it is known to molders that the fused metal is lumped around a ball of lamphlack used to facilitate the casting, then scaled over, thus forming knots and weak spots. As they contain more carbon, the current singles them out for electrolysis.

Of the corroded lead cables I have not seen any samples, but from the description given they would appear to be simple cases of lead corrosion occurring in the presence of air and moisture, and possibly decaying substances, such as manure, the electric current furnishing the warmth. The result is white lead incrustation.

III. Admitting this state of things, what is the remedy?

1. It has been suggested frequently to reverse the trolley current. That would no doubt remove the evil, if it were safe and possible.

2. It was supposed, and I think has been tried here, that the insulation of underground pipes and cables might be sufficient. That is impracticable. Where there is electrolysis, there is leakage.

1. Report prepared for Major J. B. Furay, Omaha, Neb.

3. The only practical way which suggests itself to me is to keep the current in the rails by electrically welding the rails together all along the line, and to each other, thus preparing an unobstructed broad metallic conductor for the homing current. This is being done in Brooklyn.

The next best method would be to band the rails securely to each other with a one-inch copper wire. A cross band of the same thickness should connect the two lines of rails every 100 feet, wherever the earth is sufficiently moist to render an escape to the pipes probable. In addition it is very necessary to have a heavy metallic connection between the return rail and back to the generators. If, besides, in the danger district, the rails are connected at frequent intervals with all pipes and cables along the track, there is every reason to expect an abeyance of the evil. Wherever this plan has been tried it is pronounced successful.

As we cannot, however, force the current to take one path exclusively when others are open to it, and as 1-100 of a volt difference of potential between the pipes and the damp earth surrounding them has been found sufficient to induce electrolysis, I would suggest that frequent voltage measurements should be made all over the line, even after some plan has been adopted, and that such changes in the return conductors be made as the measurements may indicate.

## The Electro-metallurgy of Gold and Silver.[1]

By A. L. Eltonhead.

I hope the following will be of interest to some of the members of this club and to others who are interested in the utilization of electricity in the cheaper methods of extracting gold and silver from their ores.

THE ELECTRO-METALLURGY OF GOLD AND SILVER.

Those who are familiar with the cyanide process know of the difficulties one contends with in using zinc shavings or zinc in any other form to precipitate the gold and silver from cyanide solutions; such as the dissolving of the zinc as the solution passes over it, and after a short time rendering the solution inert for the dissolving of gold and silver, which makes necessary the running to waste of large quantities of solution which contain considerable free cyanide of potassium, gold and silver.

There are certain unaccountable reactions that occur which prevent the total precipitation of the precious metals from the solution when using zinc shavings as the precipitant.

Large losses occur in collecting, drying and smelting the resultant "zinc slimes," or precipitate, which we all know is not a homogeneous mass, and great care is necessary in sampling it for assay. The resultant bullion is sold in South Africa for about 10 shillings ($2.40) less per ounce than for the bullion received from the amalgamated plates of the stamp mills.

There has been erected a small plant for working what is known as the electro-chemical process on the West Side mine of the Tombstone Mill & Mining company of Tombstone, Ariz.

[1] 1. From the Proceedings of the Engineers' club of Philadelphia for Novemer, 1894.

The process overcomes the above difficulties encountered in precipitation in which electricity enters as a factor, and the resultant precipitate is recovered in the shape of gold and silver amalgam.

Electricity is being utilized more and more every day in chemical and metallurgical operations, and it is not surprising that an important discovery has been recently made in which it has been found that the precious metals can be precipitated on a large working basis when they are in solution with certain chemicals such as the cyanides, with the aid of electricity for the electrolysis of certain saturated solutions of the alkaline metals or earths.

A description of the process is as follows: The ore is crushed to a certain fineness, depending on the character of the gangue. It is then placed in leaching vats with false bottoms for filtration, the same as other leaching plants. A solution of cyanide of potassium and other chemicals of known percentage is run over the pulp and left to stand a certain number of hours, depending on the amount of metal to be extracted; it is then drained off and another charge of the same solution is used, but of less strength, which is also drained; the pulp is now washed with clean water, which leaches all the gold and silver out and leaves the tailings ready for discharge, either in cars or sluiced away by water if it is plentiful.

The chemical reaction of cyanide of potassium with gold is as follows, according to Elsner:

$$2\,Au + 4\,K\,Cy + O + H_2O = 2\,KAu\,Cy_2 + 2KHO$$

That is, a double cyanide of gold and potassium is formed.

All filtered solutions and washings from the leaching vats being saved and passed through a precipitating "box" of novel construction, which may consist either of glass, iron or wood and made in any shape, either oval, round or rectangular—if the latter, it will be about ten feet long, four feet wide and one foot high—and is partitioned off into five lengthwise compartments; under each partition on the inside, or bottom of the "box," grooves may be cut, a quarter to a half inch deep, extending parallel with the partitions, to serve as a reservoir for the amalgam, and give a rolling motion to the solution as it passes along and through the four compartments. The center compartment is used to hold the lead or other suitable anode and electrolyte.

The anode is supported on a movable frame or bracket, so it may be moved either up or down as desired, it being worked by thumb screws at each end.

The electrolyte may consist of saturated solutions of soluble alkaline metals and earths. The sides or partitions of each compartment dip into the mercury, which must cover the "box" evenly on the bottom to the depth of about a half inch.

Amalgamated copper strips or disks are placed in contact with the mercury and extend above it, to allow the gold and silver solution of cyanide to come in contact.

The electrodes are connected with the electric dynamo; the anode of lead being positive and the cathode of mercury being negative. The dynamo is started, and a current of high amperage and low voltage is generated, generally 100 to 125 amperes, and with sufficient pressure to decompose the electrolyte between the anode and cathode.

As the gas is generated at the anode, a commotion is created in the liquid, which brings fresh and saturated solution of electrolyte between the electrodes for electrolysis, and makes it continuous in its action.

The solution of the double cyanide of gold, silver and potassium, which has been drained from the leaching vats, is passed over the mercury in the precipitating "box," when the decomposition of the electrolyte by the electric current is being accomplished, the gold and silver are set free and unite with the mercury, and are also deposited on the plates or disks of copper, forming amalgam, which is collected and made marketable by the well-known and tried methods. The above solution is regenerated with cyanide of potassium by the setting free of the metals in the passage over the "box."

In using this solution again for a fresh charge of pulp, it is reinforced to the desired percentage, or strengthened with cyanide of potassium and other chemicals, and is always in good condition for continuing the operation of dissolving.

The chemical reaction of forming cyanide of potassium in the precipitating "box" is as follows, per Elsner:

$$2\,K + 2H_2O = 2\,KOH + H_2.$$

$$2\,(Au\,K\,Cy_2) + H_2 = 2\,KCy + 2\,HCy + 2\,Au.$$

$$2\,HCy + 2\,KOH = 2\,KCy + 2\,H_2O.$$

Which is explained thus: The potassium, acting on the water of the solution, creates nascent hydrogen and potassium hydrate; the nascent hydrogen sets free the metals (gold and silver), which are precipitated into the mercury and form amalgam, leaving hydrocyanic acid; this latter combines with the potassium hydrate of the former reaction, thus forming cyanide of potassium. There are other reactions, for which I have not at present the chemical formulas.

As the solution passes over the mercury, the center compartment of the "box" is moved slowly longitudinally, which spreads the mercury, the solution is agitated and comes in perfect contact with the mercury, as well as the amalgamated plates or disks of copper, insuring a perfect precipitation.

It is not always necessary to precipitate all of the gold and silver from the solution, for it is used over and over again indefinitely; but when it is required, it can be done perfectly and cheaply in a very short time.

No solution leached from the pulp, containing cyanide of potassium, gold and silver, need be run to waste, which is in itself an enormous saving over the use of zinc shavings when handling large quantities of pulp and solution.

Some of the advantages the electro-chemical process has over other cyanide processes are: Its cleanliness, quickness of action, cheapness, and large saving in cyanide of potassium by regeneration; not wasting the solutions; larger recovery of the gold and silver from the solutions; the cost of recovery less, the loss of gold, silver and cyanide of potassium reduced to a minimum; the use of caustic alkalies in such quantity as may be desired, to keep the cyanide solution from being destroyed by the acidity of the pulp, and also sometimes to give warmth, as a warm cyanide solution will dissolve gold and silver quicker than a cold one. These caustic alkalies do not interfere or prevent the perfect precipitation of the metals. The bullion recovered in this process is very fine, while the zinc-precipitated bullion is only about 700 fine.

The gold and silver is dissolved and then precipitated in one operation, which we know cannot be done in the "chlorination process," besides, the cost of plant and treatment is much less in the above described process.

The electro-chemical process, which I have hastily sketched, will, I think, be the future cheap method of recovering fine or flour gold from our mines and waste tailing or ore dumps.

Without going into details of cost of treatment, I will state that with a plant of a capacity of handling 10,000 tons of pulp per month, the cost should not exceed $2 per ton, but that may be cheapened by labor-saving devices. There being no expensive machinery, a plant could be very cheaply erected wherever necessary.

The accompanying cut needs little explanation. The barrels shown are the storage tanks for solutions of different strengths of cyanide of potassium and other chemicals. The square box or vat lower down receives the pulp and solution and after filtration the solution passes through pipe shown into the precipitating box, and then into a sump not shown, from which it is pumped back into the barrels. As may be noticed, the solution will run by gravitation to the precipitating box; there it is relieved of its metals, and then flows into the sump to be pumped back into the barrels, thus causing no losses of the metals by leakage in pumping. The box is connected by the electrodes or wires from a dynamo not shown.

SUPPLEMENT.

Sir Humphrey Davy first electro-deposited the metal sodium in the year 1807, and deposited it easily into mercury, forming an amalgam by a crude though effective method. He first made a cup-shaped receptacle of moistened carbonate of soda, placed it upon a platinum plate; the cup was filled with mercury and made the cathode and the platinum plate the anode; then, with a current of electricity from a powerful battery, the metal sodium was deposited into the mercury, thus forming an amalgam. Also, in the year 1837, in the Philosophical Transactions of the Royal Society, it is stated that Dr. Golding Bird in 1837 decomposed, by means of a voltaic current, solutions of the chlorides of sodium, potassium and ammonium, depositing their respective metals on a negative pole of mercury and thus obtained their amalgams.

It has been traced back to the year 1840 that John Wright dissolved gold and silver in cyanide of potassium solutions successfully. A patent was taken out on March 25, 1840, by G. R. and H. Elkington of London, who incorporated in their patent the above discovery of Mr. Wright, for the use of soluble alkaline cyanides in any strength solutions required for dissolving metallic gold, silver or any other metal; also any compound of these metals in a finely divided condition, such as a chloride precipitate, etc. The use of cyanide of potassium or any of the soluble alkaline earths for dissolving metals has become public property since the expiration of the above patent of Messrs. Elkington.

I call attention especially to the foregoing facts to show that the ideas of using electricity for the making of alkaline metal amalgams and the use of cyanide of potassium in particular for dissolving metals were both well known years ago.

In the year 1837 electro-metallurgy was brought into prominence by the many experiments made upon the deposition of different metals; but it was not until recent years that the ideas then advanced were put into practical shape and successful operation. Modern mechanical devices and the powerful electric dynamo have made possible the rapid strides in electro-metallurgy.

In the electro-chemical process which I have described in the above paper the ideas of Sir Humphrey Davy and John Wright have been utilized to a certain extent in making sodium and potassium amalgams by the electric current and the dissolving of metals with the cyanides; but the construction of the precipitating "box" used in the described process, whereby the gold and silver only may be extracted perfectly from an old plating solution of cyanide, or from a cyanide solution leached from gold and silver ores, is new.

It is well-known to chemists that the silver of an old cyanide-plating solution cannot be satisfactorily converted into pure chloride by adding an excess of hydrochloric acid and boiling the mixture; the precipitate so obtained is of different colors and contains foreign substances; while, with the electro-chemical process, the gold and silver only were precipitated, as was clearly shown by the assay of the resultant bullion, which was 990 fine. The cyanide solution tested contained large percentages of copper, lead, zinc and iron, with small percentages of manganese, carbonate of lime, etc., which were left in the solution, not being precipitated with the gold and silver. Surely, a more severe test could not have been taken for the demonstration of the advantages of the process.

It may be suggested, since the above metals were in combination, as the double cyanide with potassium and sodium, that the gold and silver are electro-negative to hydrogenium-potassium, or hydrogenium-sodium amalgams, depending on the electrolyte decomposed. Water requires about 1.5 volts to decompose it by an electric current; caustic soda requires over two volts, yet if mercury is present to absorb the sodium as it is set free and protect it from the water, we shall obtain sodium amalgam, while the water is decomposed, at the same time forming hydrogenium amalgam. These amalgams thus formed in the precipitating "box" coming into contact with the solution of the double cyanide of gold and silver, aid the setting of them (gold and silver) free; the mercury immediately absorbs them and forms the amalgam, which is easily collected, retorted and smelted into bullion. There may be other theories advanced by those more familiar with the subject, but the results obtained are more than flatteriog.

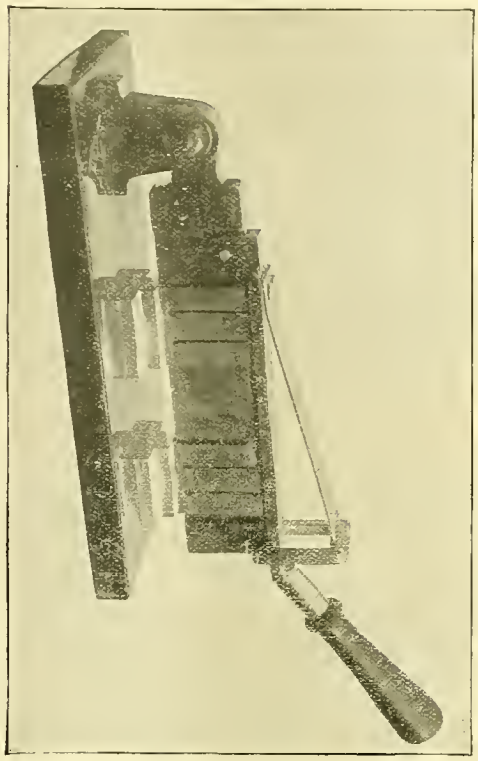
In examining the recovered gold and silver amalgam after a "clean-up," there were discovered through it hard lumps or nodules, some crystalline in form, having a bright metallic appearance, different from the surrounding mass. I would be pleased to know if any one can give an explanation of the formation of the above forms, as it presents a curious phenomenon.

The above process will be worked by the Electro-chemical Reduction company on a large scale in different gold and silver-bearing countries.

The process is not adapted to all refractory ores; some need a previous treatment, as was the case with ores tested from the Lucky Cuss mine, at Tombstone, Arizona. The ore contained silver, gold and about 35 per cent. of manganese. By the simple process of leaching, only 3 per cent. of the bullion was recovered; but by first roasting with 10 per cent. of common salt, and then by the electro-chemical process, over 92 per cent. of the bullion was extracted. Fuel is a great factor to be taken into consideration. At Tombstone wood costs, delivered, $9.00 per cord, which makes it out of the question to treat their low-grade manganese ores. In other localities, where gold is found in a finely-divided or flour condition, the cost of working this process is the cheapest known, taking into consideration the amount of bullion recovered.

In the chlorination process, if 95 per cent. is recovered from the concentrates, containing say 6 ounces of gold, there is lost 0.3 ounce, or 6 pennyweights, in the tailings. In the electro-chemical process pulp containing but 0.5 ounce gold is treated, and 85 per cent., or more, of the assay value is recovered; and there is lost about 0.075 ounce, or 1.5 pennyweights, of gold in the tailings. The advantage of the latter process is obvious, even if the cost of treatment were the same, which is not the case.

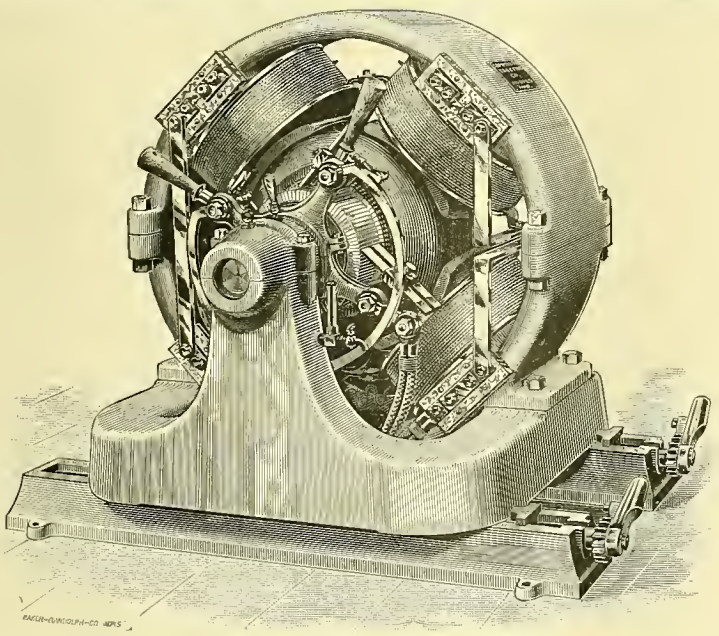
The possibilities of the electro-chemical process are unlimited, as the precipitating box may be used to extract gold and silver from the ores direct, or from other solutions than the above-mentioned cyanides.



NEW QUICK BREAK SWITCH.

## Multipolar Generators and Motors.

As improvement in the manufacture and construction of electrical apparatus is so keenly appreciated by the purchasing public, it is pertinent to call its attention to the new line of slow speed multipolar generators and motors which has recently been placed on the market by the Commercial Electric company of Indianapolis.



MULTIPOLAR GENERATORS AND MOTORS.

These machines, as will be seen from the cut, are compact and neat in appearance. Their slow speed, the small floor space required, and their high efficiency make them especially desirable for lighting and power.

The armatures, which are of the smooth core, Gramme ring type, are made of iron of a special grade having an exceedingly small hysteresis loss. The absence of teeth entirely does away with eddy currents in the pole pieces. The armatures are thoroughly ventilated, and this, together with the large cross-section of the conductors and the freedom from core loss, results in a very small rise in temperature. Each coil of the armature is entirely independent, and if damaged can be renewed without disturbing any of the others. The commutator is made of the hardest copper and clear sheet mica insulation, and the great useful depth of the segments permits of turning it down many times without necessitating renewal. The magnet frame is of cast steel of the highest permeability and is mounted on a broad cast-iron base, which carries the bearings. The bearings are of the spherical, self-aligning type, and are provided with oiling rings which dip into an oil reservoir of large capacity, so that frequent renewals of the oil are avoided. The bearings have phosphor-bronze linings, with a large bearing surface. The pulleys are of large diameter and have ample belt surface, so that the full power of the machine may be transmitted with but light pressure on the bearings due to belt pull. The field coils have a large radiating surface and thus run at a very low temperature. They are easily removed and the series coils are placed at one end of the spool, so that either the series or shunt coil can be repaired without disturbing the other. The brush holders are mounted upon a rocker arm and have independent adjustment of position and tension. The insulation is of the highest grade and will withstand a pressure of 5,000 volts between the windings and the frame. These machines are built in sizes from 40 to 100 kilowatts, and are adapted for belt driving or direct connection. Their ability to withstand the sudden fluctuations of load and the severe temporary overloads peculiar to street railway work make them especially valuable for that purpose.

A large number of these machines have been installed during the last few months, both for lighting and power work, and the Commercial company is receiving high commendations on them.

## New Quick Break Switch.

The illustration shows a design of switch for high tension currents and railroad work recently brought out by J. Grant High & Co., No. 123 North Third street, Philadelphia. In getting out this switch the inventor, George T. Eyanson, had in mind the idea to make a quick break switch in which the contact between the blade and clips remains intact, until by lifting the handle all the resiliency in the spring is stored up, then the handle piece, coming in contact with the head of the yoke, gives a dead lift, releasing the hold the clips have on the blade, and causing the blade to spring out, thereby giving a quick and long break switch. The handle piece, which is made of steel, is hinged in the back of the blade and extends through and snugly travels in the yoke, giving the additional strength to the blade and insuring it from damages arising from carelessness on the part of the operator. This application of the spring can be used either on single, double or triple pole. This style of switch is at the present time in use on the Roxborough & Incline Plane railroad and the Pottstown and Ringing Rocks road.

J. Grant High & Co. are fitting out with these switches several large railroad boards under way of construction in their shop at the present time. The firm's Chicago office is at 807 Medinah Temple.

## Overhead Trolley Line for London.

There is at least one local authority in London, says the English *Railway World*, whose attitude toward tramway enterprise might well be imitated. Hammersmith has not always rejoiced in its tramways, but the vestry has, nevertheless, kept itself free from prejudice, and when the tramways within its jurisdiction passed into the hands of a new company, which was disposed to improve the tramway facilities, the board at once gave intelligent consideration to the proposals of the company. Improvement in the service, as noted in our September number, has already been made, in so far as horse traction would permit; but the managers of the London United Tramways company have lost little time in preparing plans for the conversion of a part of their lines to electric traction. During the past month the proposals were submitted to the Hammersmith Vestry; and, while the members had little doubt of the advantages of electric traction, inasmuch as the plans provided for a line operated by the much condemned overhead wire, the committee on works, to which the application was referred, decided upon the invitation of J. Clifton Robinson, the manager of the company, to visit Havre, and inspect the overhead system there in operation. The visitors were cordially received by the mayor and representatives of the tramway company of Havre, and given every opportunity to inspect the system thoroughly. The mayor spoke most enthusiastically of the satisfaction that the citizens had experienced since the introduction of electricity, while the perfect running of the tramcars sufficed to dissipate any lingering doubt in the minds of the visitors. M. Mair, the vestry surveyor, accompanied the committee and prepared an independent report, which, as well as the report of the committee, was entirely in favor of granting the desired permission. The reports were adopted unanimously at the next meeting of the vestry, and a resolution was also passed expressing the hope that the London County Council would give early and favorable consideration to the application of the tramway company for its consent. While it is, perhaps, possible that a certain section

of the council may object to the introduction of electric traction on the ground that improved facilities for locomotion may tend to encourage the masculine citizen to absent himself from the domestic roof after sunset, there will probably be no serious objection, and, as the company has already obtained parliamentary powers for the electrical equipment of the lines, London will then have an example of electric tramways on the overhead wire system that will compare favorably with many admirable lines on the continent.

The section of line which it is at present proposed to equip extends from Shepherd's Bush, along Uxbridge road, to Acton, although as soon as parlimentary powers are obtained, the line will be carried along the Acton high street to a point near its junction with Gunnersbury lane. It is understood that the Acton local board will follow the example of Hammersmith, and readily acquiese in the plans of the company, so that no opposition to the extension of the line is anticipated; and, with the convincing presence of a well equipped electric tramway as a perpetual argument for the advantages of mechanical traction, we shall expect to see the electric system extended throughout the tramways in the western suburbs at an early day.

The overhead construction will be of the latest pattern. The wires will be suspended from steel tube standards of a light and graceful pattern, which will serve eventually to carry arc lamps when the vestry introduces electric lighting, as the company offers the free use of the standards for this purpose.

## Quick Work by the Brush Company.

About 1 o'clock in the morning of October 13th last a telegram was sent from J. E. Ridall, Pittsburg agent of the Brush Electric company, to his company's works at Cleveland, to the effect that the station of the Allegheny County Light company of Pittsburg, had been partially consumed by fire and twelve 65 light arc dynamos in the plant damaged to an extent which rendered them useless.

This telegram, through some delay, did not reach Superintendent C. W. Phipps, of the Brush company, at his residence until as late as 2 A. M. Dressing immediately, he hurried to the house of Manager A. D. Dorman of the order department, and after a hurried consultation Mr. Phipps and Mr. Dorman quickly agreed upon a plan of action. Mr. Dorman started on his bicycle, and without a light, too, to arouse the foreman, who in turn was dispatched after a force of workmen, with instructions to have as many as possible report at the works with all possible dispatch.

Meanwhile Mr. Phipps hurried to the Brush works and raised steam preparatory to starting the machinery. Before 11 A. M. the twelve 65 lighters were ready for shipment, a number of the dynamos having to be partially assembled.

Shipping Clerk H. S. Walker meanwhile had made arrangements with the Pennsylvania Railroad company for a special limited freight train. At 11 A. M. the dynamos were on board and at 3:35 P. M. they were in Pittsburg, the run having been made in 4 hours and 35 minutes, better than average passenger time.

It may be mentioned here that the railroad company went so far as to side-track its ordinary passenger and express trains in order to allow this "special" to pass. At about four o'clock the machines were on the railroad siding at the station of the Allegheny County Light company at Pittsburg, ready for installation.

General Manager S. M. Hamill, who was in New York at the time, was promptly notified that this shipment had been made and immediately set out for Pittsburg, and within twenty-four hours the twelve above mentioned machines were entered on the books of the Brush company as the quickest shipment and sale on record.

The total time consumed from the receipt of the telegram by the Brush company until the machines were delivered at the station was 14 hours.

Such magnificent work as this reflects great credit on the men who carried it out. The Brush company has, however, made a record in the line of quick shipments, and it will be remembered that this company made remarkably quick time in furnishing the dynamos after the fire at the Brush station in Baltimore, Md.

## Electric Plant in a California Mine.

An interesting electric mining installation has been in operation for some time near Oroville, Butte county, California, at the banner mine of the development syndicate of which Major Frank McLaughlin is general manager. The particular interest applying to this installation is due to the fact that all the power required for both the mining and the milling of the ore is electric. The power station is about two miles from the mine and mill, and water is obtained from the Feather river, under 112 feet head, operating two Pelton water wheels, which in turn drive two 85 horse power direct current 500 volt generators. The power supplied by the generators is utilized in driving motors operating separately a ten stamp gold mill, a rock breaker, a 10 inch by 20 inch Rand air compressor and two pumps on the 300 and 500 feet levels of the mine, of the Knowles vertical triplex, single acting type, one with plungers of 6 1-3 inch diameter and 8 inch stroke, and the other of the same type with plungers of 5 inch diameter and 6 inch stroke. The hoisting works are also operated by an electric motor and the mine and mill are lighted from the power wires. Owing to lack of water for power the hoist has thus far only been operated intermittently; but a large bulkhead has recently been built which will store sufficient water to allow of its operation at all times in connection with the other apparatus.

The following letter from Mr. McLaughlin to Thomas Addison of the General Electric company, San Francisco, Cal., attests the success attending the operation of this plant:

I take great pleasure in stating that the electric power plant installed by your company at the Banner mine, for operating the mill, rock breaker, lighting system, air compressor and the pumps on the 300 and 500 levels, works perfectly and to our entire satisfaction.

## Large Three-phase Transmission Plant With 400 Horse Power Motor.

The Pelzer Manufacturing company of Pelzer, S. C., has contracted with the General Electric company for a three-phase electric transmission plant that will be exceptionally large and interesting. At the generating station, three miles from the cotton mills owned by the company, there will be three slow-speed generators of 750 kilowatts each directly coupled to water wheels. These dynamos will generate current at a potential of 3,300 volts, and the current will be fed directly to the transmission wires at this pressure. The transmission line will consist of eighteen No. 00 wires, this size having been selected in preference to larger wire to reduce the line induction as much as possible under the existing conditions. At one mill will be located a 400 horse power synchronous motor, receiving current directly from the wires. There will be, in addition, more than twenty induction motors in various rooms. Of these fourteen will be 110 horse power motors, and the others will be of various sizes, from 5 to 75 horse power. In a sub-station will be located nine 160 kilowatt transformers for the motors and for 1,200 incandescent lights for the mills. Two electrically operated blowers of three horse power each will be used for cooling the transformers.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, December 8.—The frequently repeated statement that the Manhattan Elevated Railroad company is figuring with the General Electric company for the electrical equipment of its lines has again become current. A director of the latter company is now reported to have said that the Manhattan people decided definitely months ago to electrically equip the system and that plans and specifications have been drawn up and are in the hands of manufacturers. He would not say whether General Electric had secured the contract. He said it called for the equipment of some 257 motor cars and erection of power plants.

Watson Whittlesey has been appointed receiver of the Suburban Traction company of Orange, N. J., which operates an electric railway in the southern extremity of that city to the East Orange line and a horse railway throughout East Orange and Bloomfield. The American Loan & Trust company of Boston, which holds $1,500,000 of thirty year bonds, made the application. The receiver qualified in $30,000 bonds and has taken charge. The company's resources are estimated at $500,000. The principal cause of the failure was an accident on the Eagle Rock section in August. Suits have been brought against the company aggregating $172,000. A large number of the injured passengers have settled their claims. Foreclosure of the road wipes out the claims of those who have not yet settled. The effect of this accident was to frighten off capitalists. A large loan had been nearly consummated when the accident ended negotiations.

At a recent meeting of the Rapid Transit Commission Joseph G. Hillam of No. 25 Pine street submitted a plan for underground roads traversing different routes from those favored by the commission. He does not propose to go under Broadway, and he thinks that a strong point in its favor is that the city would still retain its yearly revenue of $150,000, which it receives from the Broadway franchise. When the commissioners came to one paragraph in the typewritten proposition of Mr. Hillman they exchanged significant glances. It read: "The construction could be done far more economically by the Manhattan Railroad company over these routes than by any other corporation; this also applies to their operating the same, and, as the existing Manhattan company would no doubt have to apply for some fresh powers from the Legislature, an independent corporation can be formed to build the underground road; then if this corporation cannot make a 'deal' with the Manhattan Railroad company it will operate independently." The Central Tunnel Railway company submitted a plan for one road having six tracks, and running from City Hall under Elm street and Fourth avenue to Forty-second street, and thence by a steel structure spanning the new steel structure now being built by the Harlem River Railroad company, thence continuing to the Harlem river, crossing it, going to Walton avenue, and continuing thence along the line surveyed and located by the previous Rapid Transit Commission, which lies substantially parallel with and within a short distance of Jerome avenue.

The New York Board of Fire Underwriters, at a recent meeting, amended Rule 22 of the "rules and requirements of the board for the installation of electric light and power," so that it provides that interior conduits "must not be supplied with a twin conductor or two separate conductors, in a single tube, unless the said two separate conductors or twin conductor, having an approved insulation, are enclosed in a complete, fully insulated, continuous iron conduit, and are in circuits installed as per table of capacity of wires, for currents not to exceed 100 amperes."

Suburban trolley railroad prospects, despite the failure noted above, are fairly good. Peekskill seems assured of an electric railroad through its streets and to various suburban hamlets. The Board of Trustees has granted to the Peekskill State Camp & Mohegan Railroad company a franchise covering certain streets of Peekskill. The Peekskill & Cortlandt Railroad company, which was also in the field for the franchise, has withdrawn. The successful company is capitalized at $175,000. Alfred E. Beach of the *Scientific American* holds almost all the stock, and is said to supply all the money. In Englewood, N. J., it looks as though the proposed trolley line from Fort Lee to Englewood would be built, although there is a curious objection. There is no denying that such a line would help Englewood in a business way, but not all the townspeople are ready to welcome it on that account. Englewood is known largely as a residence town for wealthy business men of New York. Much money is represented, and the number of beautiful houses that have been built there in the last three years, despite the hard times, is large. Building lots have advanced constantly in price, and land is away up. Many residents declare they want to keep it so, and do not want any part of the generally cheaper style of dwellings and less wealthy people who follow the line of the trolley. But many in the town favor the line, and surveyors are already at work. From Hackensack it is reported that the task of getting the consents of property owners for a trolley line is greatly impeded by the fact that the Bergen Turnpike company is very unpopular. The company, however, has all its material on the ground ready to construct the line as soon as right of way is secured. W. F. O.

# PERSONAL.

Willard L. Candee, business manager of the Okonite company, is in Chicago.

W. H. McKinlock, president of the Metropolitan Electric company, Chicago, is in the East on business.

S. D. Large of Large & Twining, Philadelphia, is receiving congratulations upon his marriage to Miss Armstrong of Philadelphia on November 28th. Mr. and Mrs. Large visited Chicago and several western cities.

# NEW INCORPORATIONS.

Cardington Electric Light & Power company, Cardington, O.; capital stock, $15,000.

Mahoning Valley Electric Railway company, Niles, Ohio; capital stock, $150,000; C. F. Clark, Niles, Ohio.

White Hall Electric company, White Hall, Ill.; capital stock, $10,000; Gilbert S. Vasseller, White Hall, Ill.

Ravenna Electric Street Railway & Power company, Ravenna, Ohio; George H. Worthington, Ravenna, Ohio.

Nutting Electric company, Chicago; capital stock, $100,000; to manufacture electric arc lamps; Carl K. MacFadden, Chicago.

Electro-magnetic Machine & Mining company, Milwaukee, Wis.; capital stock, $6,000; Frederick Weinhagen, Milwaukee, Wis.

Corning & Painted Post Street Railway company, Corning, N. Y.; capital stock, $100,000; to construct and operate five miles of electric railway.

Winamac Light & Power company, Winamac, Ind.; capital stock, $10,000; to furnish electric light and power; John H. Weaver, Winamac, Ind.

Luling Electric Light & Power company, Luling, Tex.; capital stock, $20,000; to furnish electric light and power; W. R. Johnson, Luling, Tex.

Paducah Electric company, Paducah, Ky.; capital stock, $40,000; furnishing light and power and operating street car lines; Elbridge Palmer, Paducah, Ky.

Chatham Electric Light & Power company, Savannah, Ga.; capital stock, $25,000; to operate electric light and power plants; George Parsons, Savannah, Ga.

Potomac Light & Power company, Georgetown, D. C.; capital stock, $35,000; to furnish light and power in the District of Columbia; A. H. Wilder, St. Paul, Minn.

# ELECTRIC LIGHTING.

It is reported that the council of Fayetteville, N. C., is considering the question of lighting the streets by electricity.

The council of Webb City, Mo., has been petitioned to call a bond election to raise money to erect an electric light plant. The sum of $15,000 is to be raised.

The contract for the construction of the electric plant at the Southern Ohio Hospital for the Insane has been let to the Western Electric company of Chicago for $9,400.

The Dubuque Light & Traction company has been placed under the receivership of John Ralch of Boston by Judge Shiras on application of the Old Colony company of Boston, trustee of the first mortgage of $385,000, on which the company had defaulted in the payment of interest. This company was organized May 31, 1893, by the Boston creditors of the Dubuque Electric Railway, Light & Power company, organized in 1890, and took the property out of a receiver's hands. Its floating debt is only $5,000, but with

a capital of $500,000 and bonded debt of $385,000, the latter representing the construction account, it has earned only $4,000 in excess of operating expenses. A receiver's sale is now probable as the only means of giving the bondholders any return, as the Dubuque Street Railway company, which has the better right of way, declines to consolidate.

## ELECTRIC RAILWAYS.

The far-famed Watkins Glen of Schuyler county, N. Y., is to be connected with the scarcely less picturesque glen at Havana by an electric railway. A company with a capital stock of $50,000 has been organized for the purpose.

The International & Oak Orchard Harbor Railroad company has been incorporated to construct a road about ten miles long, to be operated by steam or electricity, from Albion, N. Y., to the west side of Oak Orchard creek and to the shores of Lake Ontario. The capital is $175,000.

New Orleans was slow in adopting rapid street car transit, but now every line but one has substituted the trolley system for horse power, and that one with doubtless soon fall in with the fast-moving procession. The *Picayune* claims that New Orleans will soon be one of the best equipped cities in the country, so far as street car service is concerned.

The Rapid Transit electric street railway of Dallas, Tex., (the Commerce street system) was sold on December 4th at foreclosure sale by Sheriff Cabell to satisfy a debt of $128,000. The property was bid in for $35,000 by W. F. Thayer, E. A. Stadle and W. S. Wathen for the first mortgage bondholders. The line includes about eight miles of road and equipments.

In his annual report to the stockholders of the West End Street Railway company of Boston, President Little said that during the year the cars of the company had covered 19,000,000 miles and carried 137,000,000 passengers over the company's 272 miles of track. A beginning has been made in placing feeder wires underground, and this is progressing rapidly under the direction of the commissioner of wires. The work of the reconstruction of horse car lines to electricity is nearly at an end.

The Batavia, N. Y., & Northern Railroad company has been incorporated to construct a railroad eighteen miles long, to be operated by steam or electricty, between Albion, Orleans county, and Batavia, Genesee county. The capital is $352,000. The directors are: George A. Wingate, Jacob Cole and William H. Hazzard of Brooklyn; Robert Avery and James H. Cox of New York; Ernest Wende of Buffalo; Oren C. Steele and David D. Lent of Batavia, and Dwight S. Beckwith of Albion.

A number of Detroit capitalists have quietly formed a syndicate for the purpose of building an electric railway from the dividing line between Wayne and Oakland counties, through Birmingham to Pontiac, to give these places better connection with Detroit. E. W. Voigt, the brewer, is at the head of the syndicate, and James A. Randall, his brother-in-law, is active in the enterprise. Birmingham is 18 miles and Pontiac 28 miles from Detroit on the line of the Detroit, Grand Haven and Milwaukee railroad.

## MISCELLANEOUS.

It is announced that litigation between the Thomson Electric Welding company and the Two Rivers Manufacturing company has been terminated, and that the Two Rivers Manufacturing company has settled for the past and taken a license from the Thomson Electric Welding company on its regular terms.

A Duluth dispatch says: The Hartman General Electric company, which has expended $150,000 the past year in improvements at its station, finds its four engines, with a capacity of 1,800 horse power, are not sufficient, and is advertising for bids for two new engines whose capacity shall be 1,400 horse power.

Dr. d'Arsonval, according to a dispatch from Paris, has been giving to the Academie des Sciences an account of his method of resuscitating persons who have to all appearances been killed by an electric shock. The recent case of James Cutler of Pittsfield, who received a shock of 4,600 volts, was apparently killed outright, but was eventually revived by the d'Arsonval method, was dwelt upon at length by Dr. d'Arsonval at the meeting of French scientists.

A bridge on the arch principle, with a span of 540 feet, is in process of construction over the canal near Kiel, at an elevation of 145 feet above the level of the water, to carry the railway from Eckemforde to that town. Four cranes, two of the locomotive and two of the pivoting type, are employed, instead of the usual hoisting appliances, and are all worked by electricity. According to the *Elektrotechnishe Zeitschrift*, loads of 10 tons are raised in 20 minutes, and smaller loads at a much quicker rate. With 850 revolutions per minute the cranes develop 7 horse power, the electromotive force does not exceed 220 volts. Two compound dynamos, disposed in parallel, act as generators, driven by a steam engine of 25 horse power. Both dynamos and motors are of the four-pole type. As the consumption of the power in the cranes was of a very variable character, variable resistances attached to slabs of slate are interposed, as required, by an automatic appliance. The electric circuit comprises three parallel wires ¼ inch in diameter, with a total length in both directions of three-quarters of a mile. In order to work the cranes, which have a dead weight of their own of 33 tons, at a speed of 6 inches per second, the motor requires 40 amperes and 210 volts.

## TRADE NEWS.

It is said that there is an excellent prospect of a speedy adjustment of the affairs of Queen & Co. of Philadelphia. Meanwhile the large stock has suffered little diminution, and is being kept up in all departments, orders being filled as usual.

S. D. Large of Large & Twining, Philadelphia, has returned from an extensive western business trip with a number of large orders. He also made arrangements with the Central Electric company of Chicago to act as western agent of the firm.

The Metropolitan Electric company has taken the general western agency for the Large & Twining station and line switches, and is getting in a large stock of all sizes. The company is sending out a little booklet describing the Ideal lightning arrester, for which it is the general agent.

The Nutting Electric company, Chicago, has been incorporated by James W. Hedenberg, Carl K. MacFadden and Frank A. Smith to succeed the old Nutting Electric Manufacturing company, which was incorporated several years ago to manufacture arc light machinery. The new company will exploit the improved Nutting lamp for series, constant potential and alternating circuits, and proposes to take the field in earnest against all competitors.

The Self-winding clock company of New York, with the view of affording personal inspection of its varied assortment of clocks to the western trade, has established a branch office at 301 Columbus Memorial building, Chicago, with J. W. Forsinger in charge. This company has just installed a time plant, consisting of 45 synchronous, self-winding clocks and one programme instrument, in the Teachers' College of New York. It calls attention to its specialties—hall clocks, programme clocks, time registers, synchronized clocks and fine astronomical clocks. Office buildings, factories and colleges are equipped with time plants.

## BUSINESS.

The demand for first-class electrical house goods seems to be continually improving, and one company which is finding if difficult to fill orders for these supplies promptly is the Washington Electric company, Chicago. The demand for its well-known annunciator is particularly brisk at this time.

The Electric Appliance company is beginning its fourth business year by making some special inducements in price on the Packard transformer, which has made a great reputation for itself during the last few years for regulation and efficiency. The Electric Appliance company makes a big point on carrying a large and complete transformer stock in Chicago, enabling it to make immediate shipment from this city, and thus save customers long delays in transit.

Grier Brothers, managers of the western office of the Bryant Electric company, have received a shipment of porcelain from the R. Thomas & Sons company's factory and have in stock a complete line of porcelain tubes, knobs and insulators. This company is also making a speciality of manufacturing new designs or special pieces of porcelain desired for new devices. The Grier Brothers as managers of the western office of the Bryant Electric company also manage the western business of the R. Thomas & Sons company, manufacturer of hard vitreous porcelain. The western office with storeroom is in the Monadnock building, Chicago.

F. A. La Roche, president and general manager of the La Roche Electric Works, reports the following sales of the company's apparatus: Wernersville Insane Asylum, three 1,000 light bipolar dynamos; Burtie & Howard, one 800 light alternator; Jefferson Ice company, one 200 light dynamo; Lorraine apartment house, two 1,200 light and one 600 light dynamos, one 800 light and one 1,500 light alternator, also transformer capacity for 5,000 lights; William Hood, Chicago, one 3,000 light alternator, also one 500 and one 1,500 light alternator; McCurdy Bros., Philadelphia, one 30 kilowatt direct current dynamo; Dedham court house, one 20 kilowatt alternating dynamo; Hammond Light & Power company one 3,000 light, two phase alternating current dynamo and accessories, duplicate order; Berkeley Electric Light & Power company, one 1,500 light alternator, duplicate order. The management announces that the works are running with a full force of men and in order to make prompt delivery are compelled to run the works several evenings each week. The company certainly deserves credit for the able way in which it is handling large contracts. It has been awarded some of the largest government contracts, which were finished in a highly creditable manner.

Among the recent engines sales made by the J. H. McEwen Manufacturing company, Ridgway, Pa., are the following: Two 150 horse power simple directly connected to General Electric generators, Continental Hotel, Philadelphia; one 350 horse power simple directly connected to Walker generator, Akron Street Railway company; two 60 horse power tandem compounds directly connected to C & C generators, Dundee Rapid Transit company, Elgin, Illinois; one 50 horse power simple to Parmele-Eccleston Lumber company, Jacksonville, N. C.; two 130 horse power tandem compounds to R. Dunsmuir & Co., San Francisco, Cal.; two 300 horse power to Granite Steel company, East St. Louis, Mo.; one 150 horse power simple engine to Huntingdon Electric Light company, Huntingdon, Pa.; one 175 horse power simple for J. H. Somers Fuel company, Belle Vernon, Pa; one 280 horse power tandem compound to Scranton Electric Construction company, Scranton, Pa.; one 125 horse power to New York & Pennsylvania company, Johnsonburg, Pa.; one 85 horse power simple to Independent Electric company, Atchison, Kansas; one 100 horse power to New York & Scranton Coal company, Peckville, Pa.; one 125 horse power simple to Young & Harrington Coal company, Shippler, Pa.; one 175 horse power simple to Walter & Ferris Coal company, Salem, Ohio; and one 125 horse power simple to Scranton Electric Construction company, Scranton, Pa.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued December 4, 1894.*

530,082. Telegraph Key. Louis D. Bliss, Washington, D. C. Application filed March 7, 1894.

A noiseless transmitting key, comprising a non-resident contact support consisting of superposed layers of fabric, a conductor spirally arranged between the layers, and a contact mounted on the support connected to the conductor, are described.

530,088. Brush for Dynamo-electric Machines. Pierre J. C. Carron, Pont-de-Claix-Isere, France. Application filed February 10, 1894.

This brush comprises a sheet of wire gauze, coated and impregnated with a paint composed of plumbago and an adhesive substance, the coated sheet having its main portion arranged in zig-zag folds and its outer portion wrapped about the folded portion and its free end secured.

530,093. Electric Railway Signaling. William Daves, Jersey City, N. Y. Application filed May 24, 1894.

The system includes a signal, a circuit therefor, a normally de-energized track circuit extending in advance of the signal and provided with means for operating the signal circuit, a second track circuit extending in the rear of the signal and operating to energize the first mentioned track circuit by the presence of a train at the rear of the signal, the first mentioned track circuit being arranged to be de-energized by the presence of a train in advance of the signal.

530,114. Method of and Means for Operating and Controlling Electro-motors. Carl Moderegger, Vienna, Austria-Hungary. Application filed December 16, 1893.

The invention consists of a generator, an electric motor connected with it, independent sets of commutator brushes for the motor adapted to cause a flow of current through the armature in either direction, an oscillatory commutator brush controlling switch loosely mounted upon the armature shaft, an automatic locking device for preventing movement of the switch during the rotation of the armature shaft, stops for limiting the normal movements of the switch, and means for actuating the railway switch in either direction in obedience to the flow of the motor current.

530,115. Telephone Transmitter. Miles A. Morehouse, Wevertown, N. Y. Application filed March 28, 1894.

Combined with the transmitter box and the vibrating diaphragm are an electrode bar rigidly connected with one side of the diaphragm, parallel supporting wires arranged horizontally within the top of the transmitter box, and pendent electrodes adjustably connected at their upper ends to the wires and arranged to rest on the electrode bar at an angle.

530,145. Electrometer. Edward Weston, Newark, N. J. Application filed April 26, 1893.

The accompanying cut shows the working parts of this invention. There are two fixed, curved electrodes, *A* and *B*, each consisting of a plate substantially turned or folded back on itself, and disposed on the circumference of a circle, a centrally pivoted shaft, a radial arm on this shaft, a metal plate, *K*, carried by the arm and entering the electrodes *A* and *B*, and circuit connections whereby the plate *K* may be electrified. Claim 11 is given: In an electrometer the combination of the fixed, circularly deposed electrodes, *A D* and *B C*, the centrally pivoted shaft *H*, the curved plates *K K*[c] carried by said shaft and entering said electrodes, the coiled spring *L* counterbalancing and opposing the motion of said shaft and circuit connections.

530,176. Alternating Current Motor and Method of Operating Same. Ludwig Gutmann, Pittsburg, Pa. Application filed October 30, 1889.

The method of operating an alternating or pulsatory current motor described consists in magnetizing one of the elements by a single energizing circuit and producing a continuously progressive shifting of the magnetic polarities in the other motor element by developing currents differing in phase and current quantity in different closed circuits of a winding of the element.

530,177. Alternating Electric Motor. Ludwig Gutmann, Pittsburg, Pa. Application filed December 23, 1891.

The method of transforming electrical into mechanical energy consists in bringing the rotatable element of a motor to the critical speed through the influence of a uniphase alternating current applied to one or both of the motor elements, and then maintain the rotation by producing in this movable element currents of displaced phase, and subjecting the conductors carrying the displaced currents to the influence of a magnetic field.

530,178. Electric Conversion System. Ludwig Gutmann, Pittsburg, Pa. Application filed December 23, 1891.

The method of distributing electrical energy to translating devices, described in this patent consists in generating single phase alternating currents, transmitting them to the point of consumption, producing from the currents biphase or polyphase currents, commutating said biphase or polyphase currents, and passing the continuous current thus produced through translating devices in local consumption circuits.

530,184. Circuit Closer. Herbert V. Keeson, London, Eng. Application filed September 17, 1894.

The device comprises a block or body, a contact making push at its end, a spring connected to one of the circuit wires and fixed in the block or body so as to bear against the inner end of the push, a bent spring also fixed in the block or body in such a position that the first mentioned spring when compressed comes into contact with it, a second push at the side of the block or body with its inner end bearing against the bent spring, and a contact connected with the other circuit wire and situated beneath the end of the bent spring.

530,191. Apparatus for Extinguishing Fires. Charles E. Manning, New York, N. Y. Application filed September 9, 1893.

The arrangement includes a source of water supply and a source of electricity, an electric motor, a pump driven thereby, electric wires connected to the source of electricity and to the motor, electric switches adapted to close the circuit through the wires and operate the motor, water pipes leading from the water supply to the pump, and from the pump through the building a plurality of branch pipes, and independent valves for each leading from the water pipes, and a hose connected to each of the branch pipes.

530,192. Electric Railway System. David Mason, New York, N. Y. Application filed February 16, 1894.

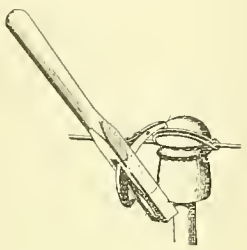
A feature of this invention is a conductor composed of a series of independent sections arranged end to end, each section of which is constructed with a tubular body that is closed at its ends, and provided with a longitudinal groove extending throughout its length in which is arranged a rib or bar.

530,208. Telephone Switch. Alfred Stromberg and Androv Carlson, Chicago, Ill. Application filed October 9, 1894.

The claim follows: In a telephone switch the combination with a support comprising a hook provided with two limbs between and from which the telephone is adapted to be suspended, of a pivoted lever, the end thereof occupying a position between said limbs, whereby said lever will be rotated when the telephone is hung up, and contact terminals controlled by the rotation of said lever for opening and closing the circuits through the telephone apparatus,

530,223. Fender for Trolley Cars. Charles F. Haug, Brooklyn, N. Y. Application filed April 5, 1894.

As shown in the cut there is a fender for trolley cars in which there is a combination of rectangular bracket arms, T pieces forming the apices of the rectangular bracket arms, means for attaching the bracket arms to the car, fender supporting arms connecting the upper and lower ends of the bracket arms, a transverse brace directly connecting the forward lower ends of the bracket arms and removably applied thereto at the rear of their extreme forward ends and a fender net attached to the fender-supporting arms, said arms and fender net extending over the transverse brace.



NO. 530,361.

530,235. Magneto-electric Machine. Joseph N. McLeod, Brooklyn, N. Y. Application filed April 2, 1894.

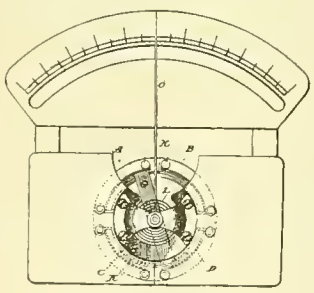
In a magneto-electric machine there are in combination with the rotary armature and the toothed rack bar and ratchet wheel for operating the armature a circuit-breaker consisting of the stationary and movable parts normally in contact and connected in the local circuit and respectively connected with the line wires, the lever connected with the movable part of the circuit-breaker, the collar connected with the lever and the tappet arm of the ratchet wheel adapted to have contact with the collar to break the circuit when the rack bar nearly reaches the end of its movement for operating the armature.

530,236. Signaling Apparatus. Bernice J. Noyes, Boston, Mass. Application filed February 18, 1890.

The invention relates to police signal apparatus, comprising multiple signal transmitting apparatus, constructed and arranged to transmit different signals and to produce distinguishing impulses with some and not with others, a central station having a receiving apparatus, a relay controlling the circuit of the receiving apparatus and in circuit with the transmitting apparatus, combined with a distant auxiliary station, a circuit-changing device also in circuit and responsive first to distinguishing impulses only, and thereafter to the regular impulses of signals transmitted, a local circuit controlled by this circuit-changing apparatus and containing a signal-receiving instrument located at the auxiliary station, and an audible alarm device located at the distant central station, whereby only special signals distinguished by certain impulses are received at the auxiliary station and their receipt on made known by the audible alarm at the distant central station.

530,253. Electric Bell. Edward G. Worley, New York, N. Y. Application filed June 13, 1894.

An open casing having a main portion to inclose the hammer-actuating devices, and having an offset with its rear or bottom on a different plane from the rear or bottom of the main portion, the rear or bottom of the offset being open with a bar across the opening, a screen covering the opening, and open frame laid over the screen, a gong, a screw passing through the gong, a bar and screen into the frame to bind all together, and a cover for the casing and means to secure it in place.



NO. 530,145.

530,260. Primary Battery. Charles W. DeMott, New York, N. Y. Application filed December 7, 1893.

For this invention is claimed the combination in a primary battery of the jar, the porous cup, the zinc elect ode and a copper electrode having the parallel slits and the strips between the slits bent out of the plane of the rest of the tube, whereby circulating passages are provided for the solution without lessening the surface area of the copper electrode.

530,276. Trolley Catcher. William F. Kendt, Buffalo, N. Y. Application filed May 26, 1894.

A stationary frame or casing having a stop or shoulder and a rotary spring-drum journaled therein, a detent pawl carried by the drum, adapted to be connected with the trolley rope and engaging with the stop or shoulder of the casing.

530,283. Conduit for Electric Railways. Michael I. Martin, Chicago, Ill. Application filed February 7, 1894.

This conduit comprises a slot rail having a downturned flange, a substructure having two upturned flanges forming a socket adapted to receive the flange, the rail and a key inserted in the socket and engaging the flange of the rail, flange, socket and key having complementary engaging surfaces, whereby when they were in place the flange and key were prevented from being withdrawn through the top opening of the socket.

530,286. Electric Tramway. Heinrich Schwieger, Berlin, Germany. Application filed December 22, 1891.

In this arrangement there is a channel in the roadway, provided at suitable intervals with electrical contacts in electrical relation with a source of electricity. An elongated device carried by the car extends below the slot of the channel for making contact with the contacts in the channel. A carrying frame is suspended on the journal boxes of the car provided with longitudinal extension flexibly jointed thereto and located above the slot in the roadway, and a laterally movable series of suspension rods depend through the slot, forming a mechanical and electrical connection between the frame and contact-making device.

530,293. Electric Switch. Ike W. Ullman, Birmingham, Ala. Application filed September 28, 1894.

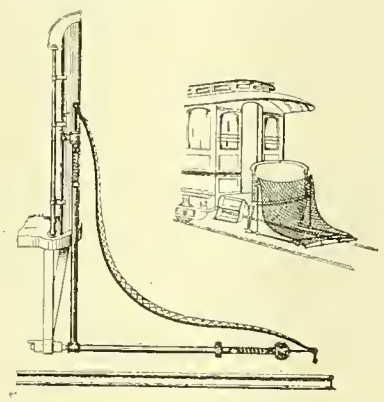
Electric contact brushes are attached to binding posts on a base, electric conducting wires are attached to the posts, a metallic frame carrying a lever is pivoted therein, an electrically insulated bolt operates in a groove formed in the base, the bolt provided with tapering heads having electric contact tips, a metallic yoke embraces the bolt, the yoke attached to the bolt by rivets operating in slots formed therein; two arms are pivoted to the yoke, the ends of the arms extending through apertures formed in the lever frame; coiled springs operate on the arms between the frame and the yoke; a concave recess is formed on the upper side of the yoke; the lower end of the lever engages the concave recess to operate the bolt to engage or disengage the bolt to the contacts on the binding posts.

530,315. Telephone Transmitter. John T. Williams, Brooklyn, N. Y. Application filed August 8, 1894.

The features claimed for the device shown in the cut are the combination of two fixed conducting blocks or bodies, both incapable of mechanical vibration from atmospheric sound waves, and a bridging piece between them, mounted upon a movable axis and subjected to a force tending to hold its extremities in contact with the respective blocks or bodies.

530,324. Telephone Exchange System. Romaine Callender, Brantford, Can. Original application filed August 13, 1892. Divided and this application filed December 18, 1893.

This is an automatic telephone exchange system, having means controlled by the subscriber for automatically connecting any two of a series of independent outlying telephone lines, in combination with a time mechanism for automatically disconnecting at the central office the subscribers after a predetermined time. The time mechanism is in no way under the control of the subscriber after the expiration of the predetermined time.



NO. 530,223.

530,325. Telephone Switch. Romaine Callender, Brantford, Can. Application filed September 15, 1894.

This sustaining device is in the nature of an inclined bracket secured to a telephone box, in combination with a telephone receiver having a sustaining extension lug or ear adapted to rest upon the inclined bracket, and a switch lever provided with circuit connections for shifting the circuit from the call bell to the receiver, and vice versa, and means for maintaining the telephone in suspended position upon the inclined bracket when the circuit is through the call bell.

530,344. Electric Dental Engine. Joseph A. Jeffery and Benjamin A. Jeffery, San Francisco, Cal. Application filed April 5, 1894.

The illustration shows a dental electric engine consisting of a motor armature revoluble between its fields within an hermetically closed casing forming a part thereof, a revoluble shaft journaled within the casing, and upon which shaft the motor armature is loosely revoluble, an electro-magnet fixed to and revoluble with the motor armature, and a disk armature revoluble with the shaft and slidable longitudinally thereon, so as to be drawn into contact with the poles of the magnet when the latter is energized, a commutator and brushes through which the electric circuit passes to the motor armature, a collar turning with the motor armature and commutator, having a brush forming contact with its surface, through which connection is made with the source of electrical supply, a wire leading from it through the motor armature to the electro-magnet, and a connection between the other terminal of the magnet and the shaft to form a ground therefor.

530,351. Electric Meter. Gustave A. Scheeffer, Peoria, Ill. Application filed July 17, 1894.

The last claim is given: In a meter the combination with magnetic poles of a drum of aluminum mounted upon a vertical shaft and adapted to rotate in front of said poles, a shunt coil and a series coil for producing two fields of displaced phase to effect the rotation of said drum, a retarding disk of aluminum mounted upon said shaft, a permanent magnet, past the poles of which said disk is adapted to be rotated, and a short-circuit about said series coil, adjusted to neutralize the effects of friction.

530,361. Tool for Linemen's Use. Solomon Smith and Milton B. Mishler, Ravenna, O. Application filed September 17, 1894.

A lever slotted at one end and cut away on one face and notched on the other, a double hook pivoted within the slot, and a spring bearing upon the hook, are shown and described.

530,399. Insulator for Electric Conductors. John H. Croskey and Joseph Locke, Pittsburg, Pa. Application filed September 28, 1894.

An insulated conductor of electricity, consisting of a metallic conductor covered with a non-metallic mineral and embedded in glass.

530,401. Battery Connection. Walter S. Doe, Brooklyn, N. Y. Application filed August 27, 1894.

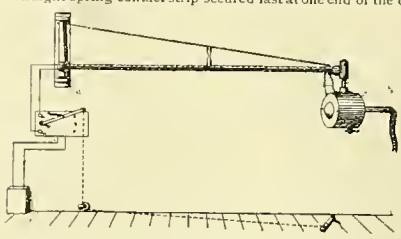
The device comprises an electrical contact disk, an elastic ring surrounding the disk and of a thickness somewhat greater than the thickness of the disk, and projecting beyond the face or faces of the disk, and means for moving the contact disk into contact with the lead plate, and at the same time compressing the elastic ring to cause the latter to hermetically seal the joint between the face of the disk and the lead plate, and a binding post or head in electrical connection with the disk.

530,411. Burglar Alarm for Safes. James W. Gilstrap, Rolla, Me., and William D. Gilstrap, Racine, Wis. Application filed April 24, 1894.

Claim 1 is for the combination with the safe of an inclosing, movable, rigid, metallic envelope, insulating media which separate them, means for making contact between them, and an electrical circuit, a circuit closer, and alarm, whereby the movement of the envelope, bodily, in any direction, closes the circuit and sounds the alarm

530,430. Thermal Circuit Breaker. Henry Klein, Janesville, Wis. Application filed May 19, 1894.

In this device there is claimed an insulator cleat, a fixed flat contact plate secured fast to one end of the cleat, a normally straight spring contact strip secured fast at one end of the cleat,



NO. 530,344.

the spring strip being outwardly bowed and having its free extremity touching the fixed contact plate at a point nearer the fast end of the spring contact strip than the length of the latter, and fusible solder fastening the free extremity of the spring contact strip onto the fixed contact plate at the point of contact.

530,432. System of Electrical Distribution with Storage Batteries. Emil Kuchenmeister, Berlin, Germany. Application filed November 25, 1892.

A system of electrical distribution involving a plurality of uniform sections of storage battery, an energizer for each section of battery, each energizer having a potential equal to its respective battery section; working conductors and means for coupling the initial battery section in parallel of the working conductors and the remaining battery sections successively in series or in parallel with the initial section in accordance with the fluctuations in the potentials of the working conductors; and for adjusting the connections of the energizers with the battery section to maintain the potentials of the battery sections and their respective energizers equal.

530,434. Burglar Alarm. John H. Lowe, Neosho, Mo. Application filed July 20, 1894.

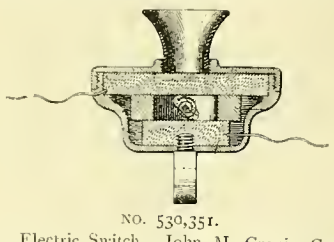
The combination comprises an inclosing movable casing for a safe provided with electric contacts adapted to make connection with the safe when the casing is moved, and an electric circuit, including an alarm, the contacts forming one terminal of the circuit and the safe the other.

530,465. Dynamo Regulator. John Van Vleck, New York, N. Y. Application filed October 8, 1894.

Two series of contact plates, each being disposed in a straight line, the plates of one series being opposite the intervals of the other, resistances interposed between the successive plates of each series and a contact piece movable over both series and constructed to bridge two plates of one series while bearing upon one plate of the other series are described.

530,466. Submarine Torpedo Boat. George C. Baker, Chicago, Ill. Application filed March 14, 1893.

The propeller shaft and engine in a submarine boat have direct connection. There is also a connection between the engine and dynamo, and between the shaft and dynamo, and a series of storage batteries, the combination permitting the utilization of electricity as a motive power.



NO. 530,351.

530,472. Electric Switch. John M. Cronin, Cambridge, Mass. Application filed September 22, 1894.

A double switch is provided with movable members, insulated from each other, a tie bar connecting the members, a handle carried by the tie bar and an auxiliary circuit controller cooperating with the members and adapted to be rendered operative by the handle to electrically connect the members.

530,482. Electric Railway Supply System. John J. Green, Boonton, N. J. Application filed August 21, 1893.

The combination is described as a closed contact box, the rock-shaft extending through packing and controlling a contact that closes the circuit in the box, a traveling shoe or collector and a switch arm outside the box normally held in the path of the shoe, at the extremity of its outward movement and moved by the shoe and actuating the shaft, the arm being arranged obliquely with reference to the line of travel of the shoe, whereby the shoe moves the switch arm in the same direction when the shoe is moved in either direction.

530,485. Primary Battery. Charles J. Hubbell, New York, N. Y. Application filed April 30, 1894.

A primary battery is described having a positive element provided with two terminal projections, and two negative terminals embedded in the battery casing and terminating in exposed contacts located within the battery casing and below the upper edge of the positive element and having each a separable contact with one of the terminal projections.

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## The Drainage Canal and its Traveling Electric Lighting Plants.

One of the great engineering works of the day is Chicago's drainage canal, which is now in process of excavation. This great channel will, when completed, extend from the West Fork of the South Branch of the Chicago River, in Chicago, to the Desplaines River at Joliet, a distance of 36 miles. It will receive a portion of the water of Lake Michigan, the current setting through the lower Desplaines and the Illinois rivers to the Mississippi. By this means the greater part of the city will be drained without contaminating the adjacent portion of Lake Michigan, which is the source of the city's water supply. When completed this channel will also be a free waterway, navigable for any craft drawing less than twenty-two feet of water. The cutting being made by the Sanitary District trustees constitutes nearly two-thirds of the entire cost of creating a channel from Chicago to the Mississippi, which would be navigable for the largest boats which will be able to ply between St. Louis and New Orleans, after the present plans for the improvement of the Mississippi will have been completed. The canal is being built under the general law for incorporating sanitary districts, enacted by the Legislature of the State of Illinois in 1889. The Sanitary District of Chicago compromises all of the city north of Eighty-seventh street, together with some forty-three square miles of Cook county, outside of the city limits, which will be directly benefited by the improvement. The population of the district is about 1,400,000, and the assessed value of real estate and other property subject to taxation is $242,438,000.

Earth was broken for the main channel on September 3, 1892, and the work now under contract extends to Lockport, which is 33 miles from the center of Chicago. For construction purposes the canal is divided into 28 sections, the work on each being given to a separate firm of contractors. Some four or five thousand men are employed in excavating operations along the line of the great ditch, and it is anticipated that the entire work, from Robey street to Joliet, will be completed by November 1, 1896. The canal varies in width from 110 to 202 feet and in no place will be less than 24 feet deep.

The different contractors make use of a variety of interesting appliances to dig and remove the earth, according to the nature of the formation encountered. The canal board requires that the excavated earth be deposited on spoil banks 180 feet distant from the sides of the channel, and huge portable structures have been devised to accomplish this work. One of these, at present near the Chicago Belt Line crossing of the Atchison, Topeka and Santa Fe railroad, is shown in Fig. 1. Here cars, especially constructed, are loaded by steam shovels and drawn by steam hoists up a steep incline to a proper height, where they run on to a tipple and are automatically dumped. Each incline is equipped with two four-yard cars, which load and dump alternately. In the illustration one of the cars is shown on the tipple while discharging its contents. The steam shovel in the ditch is capable of lifting from two to three cubic yards of earth (clay in this instance) at each operation. The incline is built of heavy timbers and sustains a double track for the dump-cars. This structure is supplied with a steam equipment consisting of an upright 100 horse power boiler and two independent 40 horse power engines, each driving a cable drum, from which the dump-cars are propelled from the steam shovel to the spoil bank and back. Coal for fuel is easily obtained, and water is secured by a long pipe connecting with the city mains. The whole outfit is mounted on wheels and rollers, and is moved along the line of the canal, as required, on temporary tracks, by means of horses. The steam shovel in the excavation is, of course, also movable, on a separate track.

The expensive machinery used in this work as well as the extensive character of the undertaking has made it necessary to continue operations day and night, and as good light is indispensable, electric illumination has been generally adopted on the different sections of the canal. The plant illustrated by Figs. 1 and 2 was installed by Gustave Monrath for the Heidenreich company, which, on its section, has four steam shovels and inclines at work. The electric lighting plant is movable with the rest of the incline, of course, and is on the side of the structure opposite to that shown in Fig. 1. It is enclosed in a separate hut mounted on a truck detached from the remainder, but connected to move with it. A view of the interior of this small traveling plant is shown in Fig. 2. Steam is supplied to an upright 5 by 5 inch Racine engine by a flexible tube connection with the adjacent boiler. This engine is belted to a 30 ampere 110 volt United States dynamo, which furnishes current for five arc and eight incandescent lamps. Two of the arc lamps are placed on movable supports, two are suspended from a scaffold on top of the steam shovel and one is under the incline at the dump, as shown in Fig. 1. The incandescent lamps are used in the engine and boiler rooms. The arc lamps are wired on three circuits, two in series, sufficient resistance being introduced to bring down the voltage for the odd one. The conducting wires have considerable slack to give some latitude in moving the outfit. The "poles" are roughly made of scantling, and the whole wiring equipment is necessarily of a rough-and-ready, temporary character. The plant answers its purpose admirably, however, and is effective and satisfactory.

FIG. 1. THE DRAINAGE CANAL AND ITS TRAVELING ELECTRIC LIGHTING PLANTS.—ELECTRICALLY LIGHTED EXCAVATING APPARATUS AT BELT LINE CROSSING.

At Lockport there are four interesting electric lighting plants supplied by Sargent & Lundy for excavating machines that are somewhat different in character. At this point the excavation is in rock, and after being blasted out the stone is raised and removed by huge double-arm, rotating, derrick conveyors on the cantilever principle. These derricks are moved on tracks when necessary, and are so arranged that one arm is swung around to get its load while the other is conveying a loaded skip to the dumping ground. Each plant consists of a Case engine and a Crocker-Wheeler dynamo placed directly on a derrick. Two of the sets consist of 13½ horse power engines and 7½ kilowatt dynamos, supplying 12 arc and 8 incandescent lamps, and the two smaller sets comprise 8 horse power engines and 4½ kilowatt dynamos, operating 6 arcs and 6 incandescents. The arc lamps are suspended from movable supports and are wired two in series, each pair on an independent 110-volt

circuit. The low potential was necessary to prevent dangerous short-circuits should the conductors be severed by flying fragments of rock. Each boom of the electrically lighted derricks has an arc lamp at the end, the current being transmitted from the plant to the swinging arms by means of a ring contact at the base.

## Direct Current Motor and Dynamo Design.[1]

DR. CHARLES E. EMERY: On account of my connection with large tests, and having recently taken up the study of electricity, I was appointed chairman of a committee at the World's Fair to make tests of the large engine-dynamos. It is well now to state one point in respect to those tests—one real discovery, I think. In ascertaining the efficiency of a dynamo it is very common to obtain the core loss and friction of the engine light, then to excite the fields and obtain the armature drag by subtracting the second set of observations from the first. Now the two quantities thus obtained it is very customary to use as the armature drag and the friction throughout the whole range of the experiments. Those experiments showed very clearly that that is incorrect for the very reasons which the lecturer set forth here to-night—the armature drag increases quite materially as the load rises. The exciting force is necessarily increased first to balance the drop through the coils; to balance the lost volts, as it is sometimes called. But there seems to be some reaction there, independent of that. At any rate, adding together the energy used in the shunt and series field, the amount increases in a very much larger ratio than the power. That necessarily increases the armature drag, and so there was no way of balancing the indicated horse power with the not only because I have had this evening's enjoyment, but because I have felt that my first idea of Mr. Dunn was a correct one, and that we may expect from him valuable work.

DR. GEYER: Mr. Dunn explained very lucidly the matter of brushes of various resistances and that we are between two difficulties—of getting too high resistance, or, if the resistance is too low, getting too much sparking. I was going to ask if he knows of any brushes being used that were individually graduated—to have, say, a good conductor for a foundation and a brass conductor over it for your next grade of conductivity, and so on, worse and worse; say that the thickness of your brush was copper, brass, good conducting carbon, poor conducting carbon.

MR. DUNN: I will answer first Mr. Emery's question concerning the shape of this second curve which was drawn. The curve was shaped like *this*. The fact that the curve *B* (Fig. 1, p. 282), does not rise as high as the curve *A* at that point is due to these two reasons: the *B* motor is expected to give 300 per cent. load for short periods without sparking. Therefore in the first place its shape is very large and strong and tough and its bearing friction is large. Also its commutator has to carry very heavy currents. Then again, in order to be sparkless it has to be a machine in which there is a great deal of iron and very little copper, a great many lines of force in the armature and very few turns on the armature to distort those lines of force. Therefore the hysteresis is large and the eddy currents are large and the field, in order to go around such an amount of iron, is also large. That makes the fixed losses very large, and for small loads, such as this, the fixed losses bear so small a proportion to the total output that the efficiency is small. As the losses that increase with the load are small with this type of machine, they do not come in and cause the curve to bend down as it does here, and so the curve rises up to this point.

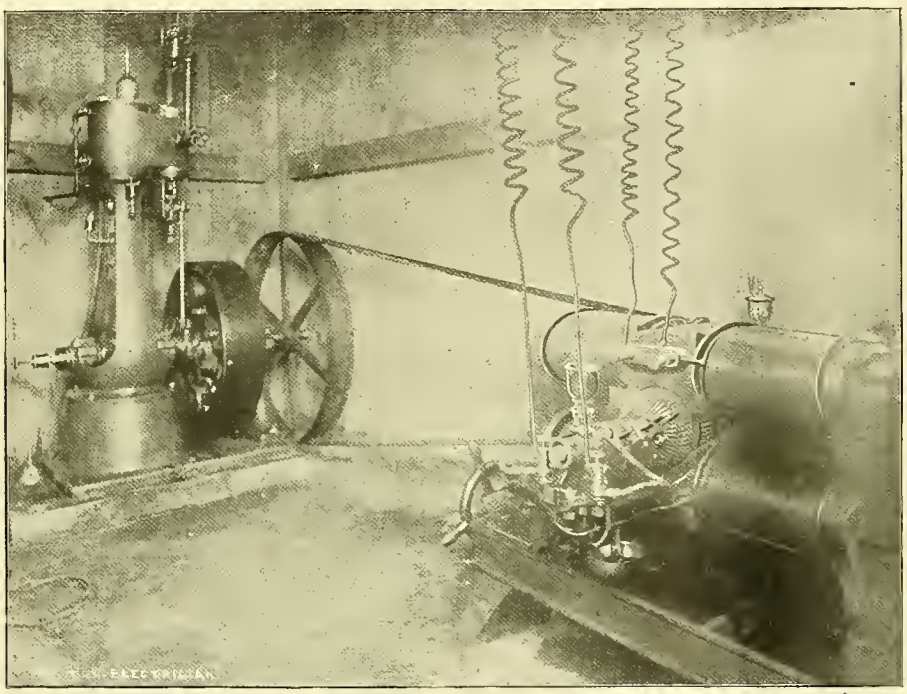


FIG. 2. THE DRAINAGE CANAL AND ITS TRAVELING ELECTRIC LIGHTING PLANTS.—ELECTRICAL EQUIPMENT AT BELT LINE CROSSING.

electric work, but by taking that into consideration; and it shows very plainly that the proper way to make tests in cases of that kind is by separate excitation, or by putting on more shunt field, without using the series field to make a series of progressive tests and bring up the voltage by the increased field and find the losses when the armature circuit is open for each of these progressive loads, and then these subtracted from the full load, or added together and compared with the external output, really give the efficiency. The efficiencies of these standard machines are lowered by this method and it is one reason why we find in practical operations that those large efficiencies are not obtained. It is not very great, but when we come to these new machines a matter of two or three per cent. is considered very large, and that difference may be accounted for in that particular way. There is one other matter, when others have discussed the subject, to which I would call Mr. Dunn's attention, and that is that in his first diagram he told us why the characteristic took the form. Now we possibly can study out why the other characteristic took the form. But he did not happen to mention it. I do not know whether he intended to or not. We should be happy to hear it if he wishes to explain the matter.

NIKOLA TESLA: I believe that all these beautiful windings shown by Mr. Dunn are due to Mr. Weston. The lecture which we have just listened to has been to me, I can assure you, a great pleasure. I cannot but congratulate the professors of Columbia College upon having such a pupil, who is able to so address an audience on this subject. I remember that in these halls I presented some years ago my first work on high frequency phenomena, and it was Mr. Dunn who first of all the students here aided me, and I remember how I felt, as he no doubt has felt this evening, in addressing for the first time an audience, and I remember how grateful I was to him for the assistance he gave me at that time. It has been a great pleasure to me to be here,

With regard to the brush mentioned by Prof. Geyer, such a brush is the Wirt brush, which is made up of copper leaves in the middle separated by paraffine paper, then lamina of some other material of higher resistance than copper, then lamina of some other material higher yet, all separated by paper. Those brushes are excellent for low voltage machines, but for high voltage machines, even the resistance of German silver is not enough to cause the forced commutation. With regard to making the carbon in different resistance throughout, that would unquestionably secure the end that Prof. Geyer suggested, but these carbons are made out of a mixture that looks like molasses—very thick clay. It is liquid almost, and it would be difficult to properly make those together, and it would be much easier to make a brush of high resistance material all through and make it so much wider. Widening the brush would have the same effect as making the parts of higher conductivity.

The dynamotor is a machine in which the armature is wound with two windings, one of which drives the core and the other of which by passing through the same field generates the electromotive force and acts as a dynamo. You cannot change the dynamo voltage, because while it gives you more lines of force to be cut, yet it makes your motor go just that much slower. To make a motor-dynamo which regulates you must have it arranged so that all the lines of force that act on your motor do not act on your dynamo. Then by varying the lines of force that act on your dynamo only you can get a variation of voltage such as that by simply connecting together a motor and dynamo; then by varying the fields of the dynamo only a rise of potential can be secured.

N. W. PERRY: I would like to ask Mr. Dunn about a device which we all saw at the electricity building which was presented by one of the German exhibitors and in which a polar ring was used. Herr Oltenheimer, who was in charge of it, spoke of it very highly, and I believe it was attributed to Dobrovolski. One of the claims that he made for it was that it would stop sparking, but I have seen that machine spark quite as violently as machines without the polar ring.

MR. DUNN: The principle of the Dobrovolski magnetic shunt is this: If we have a four-pole machine, we may want to get a fringe at a particular pole to stop sparking. In very intense fields if we move our brushes till we get just there [indicating] we will get the right amount of fringe to reverse. If we move them a little bit too far we will get so much more fringe than is necessary that they will spark very badly, and if we do not move them quite far enough we will not get enough fringe to reverse them. In other words, the entrance of the brush under this fringe is too sudden. That fringe is reacted upon by the armature reaction, and if when the brush is under the fringe the load should be removed, which allows the fringe to come back, it would come back and lap over that point of commutation a little bit, but would cause a sparking. Mr. Dobrovolski puts inside his armature a thin layer of cast-iron. At first sight it would seem that that cast-iron tube would cause a large amount of magnetic leakage from pole to pole and be of no value; but he bores it full of holes right in the middle so that he does not cause much leakage, and it has the effect of causing a gentle distribution of this fringe all the way across here. But if there is much of an armature distortion the fringe that has been driven away has to come a long distance to get back. In other words, it makes an equable distribution there and helps your commutation. As to how effective that device is I do not know. I should think that for machines in which the coils are not slipped right over the pole-pieces about the same results could be accomplished by chamfering off the edge of the poles and properly shaping them.

DR. EMERY: Perhaps it would be of interest to those present if the speaker would explain the Sayre winding.

MR. DUNN: The principle of Mr. Sayre's device is that in this little lead here which is going up, before it is allowed to touch the windings, it comes over here and in a separate winding wound on the same core just wraps itself around them a few times and then goes back and then goes up. Now with the brushes in this position [indicating] that little winding which is over here generates the electromotive force which is necessary to cause this coil to reverse right where it is without the necessity for shifting the brushes.

It is a very complicated winding and has not as yet been used in practice that I know of—not certainly to any great extent. It requires two different windings, the regular winding to do the work and then this secondary set of windings in each of these little commutator wires to do the reversing.

DR. EMERY: I recently had a letter from an engineer in England who has been investigating the matter and he said that it overcomes a great deal of the difficulties of the designs of dynamos. The winding, although complicated as spoken of, can be of very small wire, because the separate coils only come into connection as they come under the brush, and therefore they have time to cool until they can come under. There is a second paper of Mr. Sayre on the subject in which he has put them into a great number of machines and reduced the size very materially. It was not necessary to have even as much iron in as before. He did not pay any attention to this question of armature reaction except with the coils, and took it all out, and in that way was able to reduce the weights very materially and yet accomplished the results very satisfactorily.

A MEMBER: I would like to ask about the exact ratio between the width of the slot and the size of the air space.

MR. DUNN: That ratio in a machine as small as this, when the air gap is one-eighth of an inch, may be three-eighths without very much loss, but if it is made a quarter the loss is insignificant. Two to one is a good ratio in small machines. In large machines the width of the slot is made equal to or a little less than the air gap. But in small machines like this, width of slot twice the length of the air gap gives no trouble. The loss due to it is perhaps one-half of one per cent.

DR. EMERY: If there are no further suggestions I would like to express my own thanks for the very able manner in which this subject has been presented by one that we have learned to admire, and I wish to move a vote of thanks to the lecturer of the evening for his very able and interesting lecture.

SCHUYLER S. WHEELER (Communicated): During the discussion of Mr. Dunn's recent lectures before the New York Electrical Society at Columbia College on the "Designing of Electric Motors," I understood Mr. Tesla, in a very neat speech of praise of the lecturer, to mention as a matter of little consequence, in view of his praises, that all of the devices, windings, etc., described were very old and that the windings especially were attributable to Weston. I was considerably surprised at this, although Weston is entitled to more credit than he usually receives for being the originator of much that is good.

Among other things, Mr. Dunn explained what is known as the four-pole, two-brush or two-circuit winding for drum armatures and its mate for ring armatures, and in view of the fact that the Crocker-Wheeler Electric company has spent much time and a great deal of money investigating the merits and true ownership for these windings and securing the rights to them from abroad, I was surprised to hear them attributed to Weston, especially as I was not aware that he had ever done much in multipolar construction.

## Mr. Edison Says There is an Oversupply of "Electricians."

Mr. Edison has been interviewed several times of late by representatives of foreign and domestic journals. To one of the latter he said:

Unless a man means to be successful as an electrician, he would better keep out of the profession altogether, for it may be said as a general thing that the rates of compensation are diminishing because of the oversupply of men who have scarcely the rudiments and no experience to carry them along. A man has to rise to make it pay. Electricity has its business side as well as its scientific, and the masters of technical industries always will be the captains of the proletariat. It behooves a man to become a master. I think the chances for a man's success are greater in this country than anywhere else. Electricity will be mostly developed hereafter on chemical lines. It is in this direction that a man should work to anticipate the future.

1. Discussion of paper by Gano S. Dunn, before the New York Electrical Society, November 27, 1894, published in the WESTERN ELECTRICIAN December 15, 1894.

## Aluminum Leading-in Wires for Incandescent Lamps.

A plan to replace platinum by aluminum, to the use of which metal objections based on rarity are not now ever likely to apply, has been suggested by Werner Bolton, who exhibited lamps made with the substitute at the recent meeting of the German Electro-chemical society in Berlin. The coefficient of expansion of aluminum is much larger than that of glass, and direct sealing in is impracticable. The joint between glass and metal is, however, made in the following ingenious manner: The aluminum is heated in a glass tube until it fuses and the envelope of glass fuses round it. When the composite rod (having a glass envelope and an aluminum core) cools, the glass cracks; but this is of no moment, as the function of the glass is merely to prevent the aluminum melting when it comes to be sealed into the thick glass envelope which ultimately forms the base of the lamp. The arrangement is shown in Fig. 1, where the aluminum wires *Al* (about three centimeters in length) are fused into the thick glass envelope *Gl*. The glass envelope carrying the wires is shown sealed into the lamp in Fig. 2, which needs no further explanation.

The joint between the glass and the aluminum is made tight during the exhaustion of the lamp in the following manner: It is a well known fact that aluminum when amalgamated by contact with a solution containing mercury oxidizes rapidly, becoming covered with the oxide alumina, in the form of a dense powder. This incrustation of oxide, if caused to

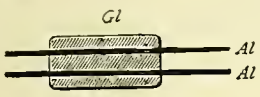



FIG. 1. ALUMINUM LEADING-IN WIRES FOR INCANDESCENT LAMPS.

occur between the aluminum wires and the glass into which they are sealed, is said to make an air-tight joint. These properties are given effect by applying a drop of a strong solution of mercuric chloride to the outer ends of the wires during the exhaustion of the lamp. The liquid is sucked in between the wires and the glass, and causes the amalgamation of the surface of the metal and its consequent oxidation, the oxide being tightly enclosed and forming an air-tight lute. As soon as the joint is tight the ingress of air is, of course, prevented, and oxidation ceases. Should a small leak occur it cures itself by the action of the oxygen on the remaining aluminum amalgam, resulting in the production of a further supply of luting material (alumina) precisely at the point where it is needed. The aspect of the wires with their coating of alumina *o o* is shown in Fig. 3. The cuts are reproduced from the London *Electrician*.

## Automatic Time Register for Street Car Service.

The Lindell Railway company of St. Louis has introduced an automatic electric time register upon its lines to enable the superintendent to see at a glance how the cars are moving over the entire system and thus enable him to know when and where lost time and blockades have occurred.

The device consists of a number of signal wires extending from the superintendent's office to the most important points on the road, such as terminals, junctions, main line and branch sections. Each wire terminates with an automatic

FIG. 3. ALUMINUM LEADING-IN WIRES FOR INCANDESCENT LAMPS.

contact device which is operated by the pressure of the trolley wheel of a passing car. The contact device consists of a metallic lever suspended slightly above and on one side of the trolley wire so that its lower end will engage one flange of the trolley wheel. The upper end is supported by a hinge and is in permanent connection with the signal wire, but is insulated from the trolley wire. The passing of the trolley wheel connects the signal wire to the trolley wire whenever one of these levers is passed and transmits a signal to the automatic recording device in the superintendent's office. The recording device consists of a slow-moving chronographic device. The motive part is an ordinary tower clock movement. The hour hand arbor transmits power to a cylinder 24 inches long and 6 inches in diameter. Over this cylinder is carried a sheet of blue paper about 23 inches wide, supplied from a continuous roll. Above this cylinder is arranged a number of electro-magnets, one for each signal circuit. Each lever carries a needle which when the electro-magnet is energized is thrust downward, punching a hole in the blue paper on the cylinder, which is grooved to correspond with the position of the needles. The paper is ruled crosswise into five minute time intervals and is perforated in like manner on both margins. These perforations engage with two sets of propelling pins on the ends of the cylinder, thus giving a positive movement to the paper. Each signal circuit registers a line of perforations on the blue paper. When the cars are running on time, that is, with proper intervals between them, the perforations will appear at regular time intervals on the paper, otherwise the perforations will be spaced more widely apart. The length of delay and time of occurrence is therefore shown, and from the time schedule it is readily determined what car was due at that point and the crew can be required to make an explanation of the delay. The sheet is timed either by hand or by an electric time stamp and at the end of the day is cut

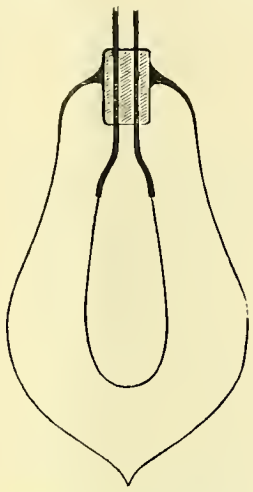


FIG. 2. ALUMINUM LEADING-IN WIRES FOR INCANDESCENT LAMPS.

off in one-day lengths, rolled up, labeled and laid away for future reference. The advantages of such a system of records will be obvious to every street railway manager.

## Electrical Mining Operations in Germany.

In the "Jahrbuch für das Berg und Huttenwesen" Herr Georgi, imperial mine administrator of Germany, speaks of the chain haulage plant operated by electric power at the Zaucherode coal mine. This chain haulage, which extends a distance of 320 meteres, is effected by means of a Schuckert electric motor which is supplied with current by a dynamo which, at 880 revolutions, gives a current of 20 amperes at 410 volts. The motor runs at 1,150 revolutions, and, as the speed of the chain only reaches two feet per second, a considerable reduction is necessary. This is effected partly by worm gearing and also by means of two reductions by belts. As the shaft upon which the driving sheave or pulley for the chain is arranged makes 11½ revolutions a minute, the ratio of conversion is as 100 to 1. The generating dynamo supplying current for the operation of the electric motor, and therefore of the chain, is driven by belt from a steam engine. The current is led to the motor partly by a 19-strand lead-covered and armored cable carried on porcelain insulators, and partly by an unarmored cable arranged on similar insulators. The mechanical efficiency of the electric motor—that is to say, the ratio between the current delivered to it, and the mechanical power given off by it—is as follows:

| | Per cent. |
|---|---|
| At mean load | 85 |
| At full load | 88.8 |

Of the power given off at the shaft of the generating dynamo, that profitably utilized on the shaft of the electric motor is:

| | Per cent. |
|---|---|
| At mean load | 65.4 |
| At full load | 68 |

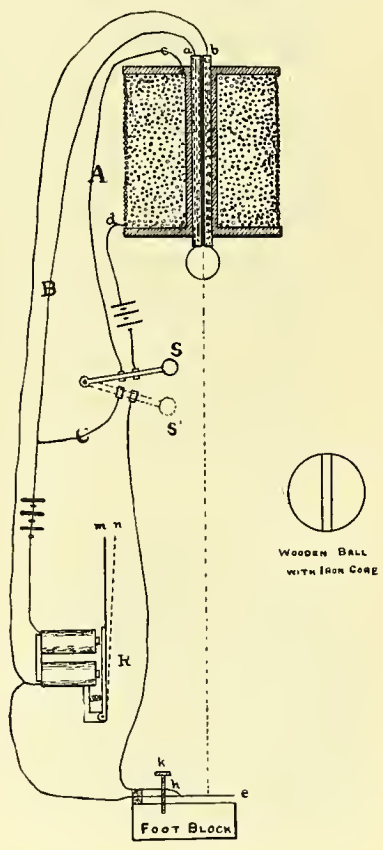
Of course, in consequence of the three reductions required to bring the speed down to 11½ revolutions a minute for the pulley driving the chain, the efficiency is lower than it would otherwise have been. In fact, the losses through this triple reduction are estimated to amount to between 7 and 8 per cent.

An electric mine ventilator has for some little time been at work at the Vereinigte Bonifacius pits, near Kray-Gelsenkirchen. The ventilator is of the Capell type, and direct current, high pressure dynamo and motor are used. The steam engine, which is supplied with part of the surplus steam from the boilers at the mine, runs normally at 60 revolutions and gives 64 indicated horse power. It has a grooved fly-wheel, and drives, by means of five hemp ropes, a grooved pulley on a countershaft, from which the generating dynamo is actuated by belting. The ratio of reduction is as four to one. The generating dynamo, which has a speed of 430 revolutions a minute, gives 42 amperes at 1,200 volts. The current from this machine, of which a duplicate will shortly be erected, is conveyed by means of four bare copper wires carried on porcelain insulators on eighteen iron masts, ranging from 30 feet to 46 feet high, to the point of utilization at No. 3 pit. Here it is received by an electric motor which, at 200 revolutions a minute, gives a power of 60 effective horse power. This motor is coupled to a Capell ventilator three meters in diameter and two meters wide, and yielding an average of 2,000 cubic meters of air per minute. A second ventilator to act as reserve will shortly be installed. A series of tests with this ventilating plant has been carried out. It was found that the steam engine had a useful efficiency of 83 per cent.; that the useful effect of the total installation—that is, the relation of the useful work of the ventilator to the indicated steam power—was 48.9 per cent. and that the efficiency of electrical transmission over a distance of 1,500 meters amounted to 82.9 per cent.

## Method of Measuring Atmospheric Resistance.

In the course of an interesting article in the November *Proceedings* of the Engineers' club, Philadelphia, on the measurement of atmospheric resistance, a method is described in which the beginning and ending of the interval are both recorded by the breaking of an electric circuit under precisely similar circumstances. By these means are avoided all uncertainties involved in the hysteresis of the recording magnet; the resistance of the circuit is practically the same for both circuits; the friction of the recording stylus is the same for both records—in short, any circumstance affecting the recording of one end of the interval will probably act with equal effect at the other end. Fortunately, however, there is no uncertainty even here, for if for any reason there is any difference, it is easily detected by the difference in the character of the curves drawn by the recording stylus when it flies back.

In the experiments described in the paper two balls were used. One was of soft Norwegian iron, carefully ground and polished to exact sphericity, with diameter of .503 of an inch. The manufacture of the other ball cost much patient care and work. It was desired to have a ball that was truly spherical, of the same volume as the iron ball and yet of much less weight, to consist partly of iron so as to be attracted by a magnet, and finally to be perfectly symmetrical about its iron axis so as not to whirl while falling. This was accomplished with all necessary accuracy, as fol-




METHOD OF MEASURING ATMOSPHERIC RESISTANCE.

lows: A cylinder of soft iron, about 3-32 inch in diameter and something over ½ inch long, was carefully turned on a watchmaker's lathe. Without taking the piece out of the chuck, a block of white maple wood, a little over ½ inch cube, with a hole drilled in it the size of the cylinder, was forced over the cylinder. Extreme care was taken that the cylinder was not bent or its centering altered during the operation. The tail center returned to its place perfectly immediately afterward. The turning of the wooden ball then began. Toward the last the ball was ground by means of a steel plate with a hole ½ inch diameter through it, the edges of the hole being very perfect. The tail center was removed, the nub at that end carefully ground down until the sphere was perfect except its attachment to the

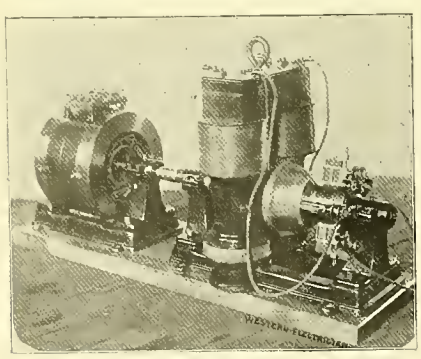
chuck by a piece not more than 1-16 inch in diameter. This was sawed off and finished with a file. The result was a ball measuring by micrometer calipers .503 inch in every diameter, and hence of precisely the same volume as the iron ball, weighing less than one-fifth as much as the iron ball, with enough iron to be held by the magnet, and yet so symmetrical that when tested by dropping from a magnet to a piece of putty, it would invariably strike the putty with an orientation exactly parallel to that when hanging to the magnet. As it certainly could not whirl and invariably regain its original orientation immediately before striking, it probably did not whirl at all.

The accompanying diagram will show the principle of the apparatus employed. The core *a b* of the supporting magnet was made of concentric layers of thin, soft iron (tin-type plate) in order to reduce hysteresis to a minimum. It was then cut in two parts, and the two halves insulated by a sheet of rubber. When the switch *S* is in the position as shown in the cut, the core *a b* is magnetized, and the ball being placed in position, is held there by the magnet. When the switch *S* is turned to the position *S'*, the current through circuit *A* being broken, the ball is free to fall. But while the ball hangs there, the ball itself (or the iron core of the wooden ball) closes circuit *B*, and the recording stylus *R* will be drawn to the position *m*. When the circuit *B* is actually broken by the ball leaving the magnet, the stylus *R* will be forced back by the spring to *n*. When the switch *S* reaches the position *S'* connection is again established through circuit *C*, and the stylus *R* is drawn back to *m*. When the ball reaches the "foot block" (about 8 feet below), the thin horizontal steel plate *e* is depressed slightly, and contact with the tongue *h* is broken, the current is again stopped and again the stylus is forced back to *n*. By means of the set-screw *k* (which does not touch the plate *e*), the tongue *h* can be raised until it touches the plate *e* just enough to make electrical connection, and the merest touch of the plate *e* by the falling ball is enough to break the connection.

## Combination Motor and Dynamo for Telegraph Offices.

Telegraph offices in the large cities have for some time been supplied with current by dynamos located in their buildings, and in many cases boilers, engines and machinery have entailed great expense and care. Many offices have been in a peculiar state, not large enough for a dynamo plant such as has been installed in the important offices, and too large for battery supply. Especially has this been true in the case of the Western Union office at Concord, N. H.

This trouble has been remedied recently by the Granite State Electric company, which has combined one of its three-phase induction motors with a direct current dynamo built expressly for this purpose. The only commercial power circuit at that place is the three-phase from Sewall's Falls four miles distant. As will be observed in the illustration, the dynamo has four carbon brushes. Two of these are connected and form the ground wire; the other two have a difference of potential of 240 volts, and each has a difference of 120 between the ground wire. The machine illustrated is of one horse power, and the entire outfit can be covered by a box 3 feet by 1½ feet and 2 feet high.



COMBINATION MOTOR AND DYNAMO FOR TELEGRAPH OFFICES.

The combination was designed and built by Abe L. Cushman, the inventor of both motor and dynamo, and is a handsome piece of machinery.

The official inauguration of the electric overhead trolley system at Havre, France, took place on September 25th, and the several street car lines of the city, comprising a total length of about 15 miles of single track, are now operated by electricity. The dynamos are of the four-pole Thomson-Houston type, and are driven through rope gearing by Farcot-Corlisss condensing engines.

## Experiments on Two-phase Motors.[1]

C. F. Scott: I have been very much interested in Dr. Duncan's method, especially as I had the opportunity of seeing the apparatus and his collection of dynamometers for making all the measurements simultaneously. The small variations in the curves are in the form of higher harmonics which result from the construction of the motor itself. We are apt in these theoretical discussions to leave out the bearing of the exact form and construction of the apparatus. The assumption, for instance, which has been made that the wave form given by a smooth core armature is necessarily a sine-wave is not a correct deduction, because the wave is of course due to the distribution of the magnetic field and also the distribution of the winding, and it so happens that as machines are usually built, smooth core machines do give sine-waves very approximately. The statement has been made by Prof. Anthony that either the two-phase or the three-phase combination should give uniformly revolving fields, that is, fields in which the polar line revolves uniformly and retains a constant value. That again assumes a certain form of construction. If we were to use a machine of four distinct poles, as a two-phase machine——

Prof. Anthony: I was assuming that the wave was a true sine-wave.

Mr. Scott: Very good. Let us take true sine-waves and put the two currents around the poles of the four-pole motor. Then it is probable that in the center of the space, the position which would be occupied by the shaft of the machine, we would get a uniformly revolving field, because there would be two fields at right angles, varying according to the sine law. But if we consider a position at or near the ends of the poles, then we may have a coil which in moving will embrace the lines which come from one circuit at one time, from both circuits together at another time, and from the second circuit alone at another time. Therefore we do not have the combination of the fields for both circuits at all times. For instance when one circuit is at its maximum strength we may embrace all its lines in the coil and not begin to embrace any lines of the other circuit until a certain time has elapsed, possibly corresponding to 15 or 20 degrees, so that there will be a change in the induction through the coil, because one circuit has begun to decrease in its value before the other has begun to thread any of its lines through the coil. So that even with true sine-waves we may not in actual machines, unless especial attention is given to construction, produce the effects of a uniform revolving field.

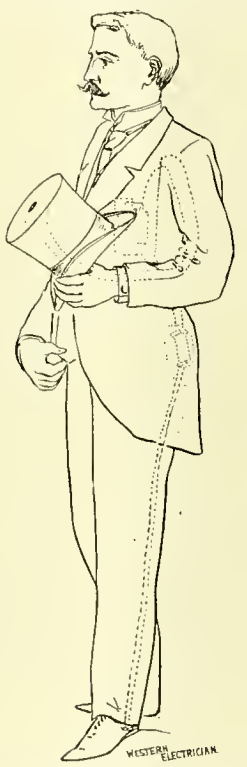



FIG. 1. CLEVER TELEPHONIC DETECTIVE WORK.—WIRING A MAN AS A TELEPHONE STANDARD.

With regard to the influence of harmonics in the rotating field, I will have to differ from the statement which was made that the field would be found to be uniform in its intensity although harmonics were present. Several years ago I was engaged in the testing of some motors, the first motors of the Tesla type, by the way, which were used for commercial work. I had gone over the designs and had tested some preliminary experimental motors and thought I had everything covered with regard to the construction of the motors. A number had been made and in the test of the first one the motor had been carrying its load for an hour or more when I found an unduly high temperature. I found the speed had fallen from synchronism fully fifty per cent. more than it should have fallen, and the motor instead of coming up to a definite temperature kept going up on what was a rather straight line. I had a second generator started and transferred the motor from the generator that had been running to the new one. The speed immediately came to what it should be and the temperature began to fall, although the load was the same. The heating of the motor with one generator was equivalent to what would have been obtained by carrying half or two-thirds additional load with the second generator. The second generator, the good one, gave a curve which was approximately a sine-curve. The other generator gave a wave form which was measured and found to be very much depressed at the middle, where the sine-curve is maximum, showing that the third harmonic was very strongly present.

An analysis of the effect of the third harmonic in the rotating field shows some rather interesting relations. The third harmonic evidently tends to a synchronous speed which is three times as great as the fundamental, so that if we have present a third harmonic we are tending, of course, to two speeds of rotation, the speed of the fundamental and one three times as fast. This third harmonic, however, is negative in its tendency to rotation. That is, the fundamental produces rotation in one direction and the third harmonic not only tends to produce a different speed, but it is in the opposite direction. This can be very simply shown by drawing a sine-wave and its third harmonic, and also a second wave which is a quarter-phase from the first, together with its harmonic. You will notice that if the first fundamental comes before the second one, that the third harmonic of the first comes after that of the second one. Consequently the fundamentals tend to rotation one way, and the third harmonics in the opposite direction. By different relative values of the two we may get almost anything. We may get normal rotation or no rotation at all, or rotation at normal speed in the opposite direction, or twice normal speed or three times normal speed.

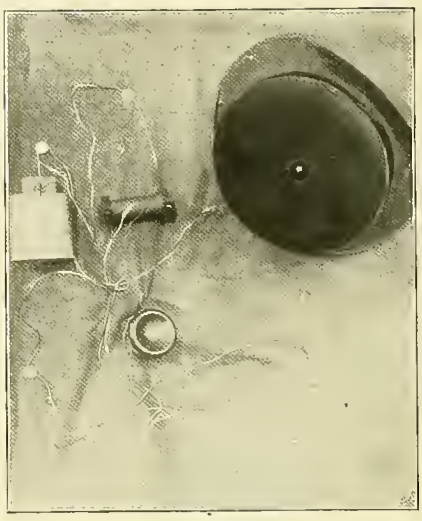


FIG. 3. CLEVER TELEPHONIC DETECTIVE WORK.—EXTERIOR OF THE HAT.

With regard to the higher harmonics in ordinary commercial working, it is to be remembered that those which are produced by iron cores are produced in what may be called the leakage current which flows around these cores, commonly transformer cores, for the purpose of magnetizing that part of the apparatus; and that these higher harmonics will usually be but a small per cent. of the so-called leakage or magnetizing current. Again, magnetizing current in commercial apparatus is in general but a small per cent. of the current at full load, usually only a very few per cent., so that the higher harmonics are only a minor effect in the magnetizing current, and this is to be but a few per cent. of the full load current for which the apparatus is in general designed. Therefore we need not be greatly afraid of the influence of those harmonics in producing trouble in commercial circuits. There are conditions and times when they must be carefully guarded against and profoundly respected.

A beautiful and simple method of showing higher harmonics was called to my attention not long ago by a young man in our laboratory, and is well worth considering. A thin iron plate (one about six inches wide and 18 or 20 inches long gave the best result) is placed in an alternating field set up by current passing through a coil. The familiar tone of the dynamo itself is heard. If the plate be bent slightly, the sound changes. At first it is a sort of a general hum, but by bending the different harmonics are brought out and may predominate. The octave, and the third, and so on, running up the scales, give their different musical tones very clearly and very purely, and by quickly changing the plate you can run through the scale with almost the beauty and clearness of a musical instrument. It might be possible to take all these sounds which are produced by the alternating current, by using some good resonator for giving all the tones together, and then pick them out and thus analyze the different harmonics by means of acoustic apparatus.

Dr. Pupin: In reply to Mr. Scott's remarks I wish to state that in a rotary magnetic field the intensity practically remains constant under conditions specified in my paper. These conditions correspond to practical conditions, when there is no polyphase motor on the circuit. It would never do to exterpolate and guess what would happen under some other conditions. I stated in the conclusion of my paper that rotary magnetic fields produced by reasonably well constructed machines are not accompanied by fluctuations in their intensity. What I mean by a reasonably well constructed machine is simply a machine which produces an electromotive force that may be a complex harmonic; but the upper harmonics are weak in comparison with the fundamental. In the particular machine that my students experimented with, there were upper harmonics, there were the third, the fifth, the seventh and even the ninth, but the rotary magnetic field was nevertheless of constant intensity. As soon as we depart from conditions met with in practice

1. Discussion of paper by Dr. Louis Duncan, I. H. Brown, W. P. Anderson and S. Q. Hayes, before the American Institute of Electrical Engineers, Philadelphia, May 18, 1894, and published in the Western Electrician July 14, 1894.

we can, if we wish, introduce all sorts of complications as in the case described by Mr. Scott, where the generator had a very strong third harmonic.

## Clever Telephonic Detective Work.

Through the co-operation of lawyers, electricians and detectives a clever exposure of an attempt at blackmail was recently made in Chicago by the use of a telephone concealed in a hat. As the result of the ruse a detective in an office building was enabled to listen to the conversation of a rascally lawyer and his intended victim, although the latter two were closeted together in an inner room at a considerable distance from the listening detective. The knowledge, obtained afterward, that his boastful confession had been overheard by a third person induced the culprit to make a full confession.

Briefly stated the facts leading up to this unique use of the telephone are these: Several weeks ago Luther Laflio Mills, the widely known Chicago lawyer, received a business call from Dr. Peter Janss of No. 3411 Cottage Grove avenue, who was in deep trouble, and desired professional assistance. A man had been writing letters to Mrs. Janss. This man, he said, was a lawyer named Charles Ioas, with an office in room 401 Ashland block, with whom Dr. Janss was for some years intimate, but with whom he had a disagreement over a year ago. Soon after the alienation began a clerk in Dr. Janss' office received a typewritten letter signed "Thomas Jefferson," requesting him to hand an inclosed note to Mrs. Janss. The writer said: "Do not let the doctor see it; it's about girls." The clerk, however, handed the letter and the inclosure to Dr. Janss instead of Mrs. Janss. Dr. Janss suspected Ioas at once, and went to him and accused him of it. Ioas boldly admitted it and defied Janss.

Mr. Mills decided at once that additional evidence against Ioas would be necessary before it would be wise to make an arrest. He called in Postoffice Inspector Stuart, and the practicability of proving the crime by comparing the letter with other work done on Ioas' typewriter was discussed. This plan was abandoned, and then Mr. Mills suggested the use of a telephone to get additional evidence of Ioas' confession. Subsequently Mr. Mills consulted with his old friend J. P. Ellacott, an electrician, and a line of procedure was soon agreed upon. During this time Dr. Janss was having occasional interviews with Ioas, in which Ioas would confess his authorship of the letter, but he was careful not to do so in the hearing of any third person. It was decided, therefore, to conceal a telephone on Dr. Janss' person, by means of which a third person at a distance could hear Ioas' confessions.

Of course the great difficulty in the way of executing this plan was the seeming impossibility of concealing a telephone and conducting wires about the doctor so effectually that the suspicions of the wary Ioas would not be excited. The task was, however, entrusted to J. J. O'Connell of the Chicago Telephone company, who exhibited much ingenuity in planning the electrical details that made possible the complete success which attended the bold experiment.

It was decided to place the transmitter in the crown of the doctor's high silk hat, as he was accustomed to wear a tall hat and could easily hold the tile almost in Ioas' face without exciting suspicion. This was done, and the apparatus shown in the accompanying illustrations was used. Fig. 1 shows Mr. O'Connell's plan of wiring the doctor—a very literal example of concealed wiring, in fact. A long-distance transmitter was fastened in the crown of the hat by four leather straps and concealed by a false lining. All non-essential parts were removed, and although the diaphragm was directly beneath the ventilator hole of the hat, it was adapted to receive sound vibrations from all directions. The conducting wires—two in one wrapping—were led between the body of the hat and the lining to the doctor's left hand and under his cuff, precaution being taken to grasp the hat in such a manner that the wire could not be seen. The double wire passed up the left coat sleeve to an inner breast pocket in the coat, where the circuit was divided and connected in such a manner that the transmitter was in series with a battery cell and the primary winding of an induction coil. The battery—a double Fuller cell—was in the inner coat pocket and the induction coil was snugly tucked away in the left hip pocket of the trousers. The connection between these pockets was easily managed, and from the secondary winding of the induction coil the dark-covered double wire passed down the inside of the left trousers leg to a screw and washer on the side of the shoe-heel, where it was fastened, so as to trail after the doctor as he walked. Thus equipped Dr. Janss was in position to offer his hat to Mr. Ioas to be talked through.

Fig. 2 is a representation of the interior of the hat used, with the transmitter fastened in the crown, and also showing the circuit, battery, coil and receiver. Fig. 3 shows the exterior of the hat and also the other apparatus. The induction coil was wound especially by Mr. O'Connell and was of unusual strength. The conducting wires were composed of five strands of No. 34 copper wire wound with brown silk. Two wires thus prepared were combined to form a twin-conductor by an outside wrapping of brown silk. About 100 feet of wire was provided, and the doctor was given several loose coils to pay out if the wire caught on an obstruction in entering Ioas' office. The receiver at the listening end was an ordinary head-telephone.

An appointment for an hour about dusk was made by Dr. Janss with Ioas, and when the decisive moment arrived the apparatus, which had, of course, been tested, was found to work without a hitch. Accompanied by Detectives Sandmeyer and Stuart and Electrical Engineer O'Connell, Dr. Janss appeared on the scene of action. The final touches to the doctor's wiring and equipment were made and he boldly made his way into Ioas' presence, hat in hand, and trailing the tiny wire behind him. The detective with the receiver at his ear sat in an adjoining room that had been secured, while the electrician made occasional sallies into the hallway to keep an eye on the circuit. Ioas, naturally suspicious, took every precaution, as he thought, against being overheard. He took the doctor alone into an inner office, closed and secured the door and even sent a confederate out in the hallway to walk up and down to prevent any listener lingering at the outer door. But no one save those in the secret noticed the wire leading under the door and down the hall to the detective's room. Once assured

FIG. 2. CLEVER TELEPHONIC DETECTIVE WORK.—THE HAT THAT WAS TALKED THROUGH, WITH CONNECTIONS.

that no one but Dr. Janss could hear him, the blackmailer talked freely and without reserve into the doctor's hat, which was only a few inches in front of his nose. In response to the doctor's artful questions he repeatedly admitted the authorship of the letter, and even boasted of it—and Detective Stuart, at the other end, heard it all and carefully took notes. In the meantime the watchful electrician was on pins and needles lest the wire should be discovered. When a janitor came along and placed a pail of water directly on the wire, it looked as though discovery were certain. But the man did not see the wire, and presently went to another part of the building. The conversation lasted nearly an hour, and during it Ioas never suspected that he had been trapped. But afterward, when Inspector Stuart confronted him with a written report of his conversation with Dr. Janss, Ioas broke down and confessed everything to the inspector. The result of this was that United States Commissioner Wirt held Ioas to the grand jury in bonds of $1,500.

The result was due to the fright given to Ioas by the knowledge that his own language had been overheard, and it is doubtful if the evidence of a telephonic listener would have been admitted against him in court. But precisely the calculated effect was produced, and the accomplishment will stand as an exceptionally clever bit of electrical detective work.

As the result of Bell opposition at Toledo and other points the Harrison International Telephone company has announced that it will defend any and all suits for infringement at its own expense and pay all judgments secured.

## BLOW AT THE BELL MONOPOLY.

### United States Circuit Court Decides the Berliner Patent to be Void.

On Tuesday, December 18th, the United States Circuit Court at Boston, in the case of the United States against the American Bell Telephone company, handed down a decision declaring the Berliner telephone patent void.

There were two grounds on which the government attacked the Berliner patent, and on both grounds the court decided against the company. The company has the right of appeal to the United States Court of Appeals within thirty days.

Ex-Solicitor-general Aldrich of Chicago considers this decision a great victory for the fair and just administration of the patent laws. The Berliner patent, he thinks, was undoubtedly delayed in the Patent Office for a purpose, and it would be a travesty on justice to extend the term of the telephone monopoly for the period of this purposely delayed patent. As this suit was begun during Mr. Aldrich's term of office in Washington, in the closing days of the Harrison administration, his friends are congratulating him on his professional sagacity in view of the outcome.

Of course the case will be appealed, but, whatever the ultimate result, the present decision stands as the greatest blow ever given to the American Bell Telephone company. The fact that the court decided adversley to the Berliner patent is greatly to the interest of all telephone users.

## Electric Railways in Chicago.

C. T. Yerkes, president of the North and West Chicago Street Railroad companies, is not popular in Chicago, but it appears that his adoption of electric power is making him better liked. The *Chicago Tribune* of December 9th says: The people of Lake View living in and adjacent to Southport avenue celebrated the opening for traffic of the Southport avenue electric street car line. They were given a free ride on a train over the new road. They cheered and yelled and blowed tin horns all along the line, and the feature of the whole thing was that every time the name of Mr. Yerkes was mentioned they all cheered louder. When they got tired riding up and down the new road the train pulled up in front of Alderman Hage's saloon in Northwest Turner Hall. Refreshments were dispensed there to the enthusiastic citizens. Alderman Hage made a speech. Superintendent Sconnell, representing Mr. Yerkes, responded. Then speeches were called for from M. J. Faherty and E. Kopriwa, the two citizens of Lake View who are given all the credit for the acquisition of the new road. The first car was run over the road Friday evening and the first train for business was started yesterday morning. The line runs on Southport avenue, connecting with the Clybourn avenue cable line on the south and the Clark street electric line on the north. The promotion of the enterprise was begun three years ago.

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## HIGH WATER MARK

CIRCULATION, 16,630.

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THE organization of a telegraphic historical society has been effected at Washington, as was noted in this journal last week and much interest has since been manifested in the project. The object of the organization is praiseworthy and appeals to all who are interested in electrical progress even though they may never have been engaged in telegraphy. The gentlemen who have brought the society into existence deserve the commendation of the electrical fraternity.

THE utilization of the electric railway service by the government for the improvement of the mail service, especially in the larger cities, is extending, and it is pleasing to note that the arrangement is highly satisfactory to the postoffice department and the people. Cleveland is the last city to which the attention of the postal authorities has been turned. Last week the assistant superintendent of railway mail service visited that city and made arrangements with the Cleveland Electric Street Railway company for the collection and delivery of the mails. Letter boxes will be placed on electric trains on all the lines. The government proposes to pay the street car company the same rate as is paid steam railroads, which is $42.75 for every 200 pounds per mile per annum. It is probable that the service will be started very soon. If the plan works satisfactorily, it is announced, special electric cars will be built and run over all the lines in the city. The present arrangement will in no way interfere with the regular service of the company, and many advantages may be gained from it.

A PALMYRA, N. Y., correspondent of the *Rochester Herald* suggests the substitution of "electroblight" for "electrocute"—a very badly formed word that has gained wide currency in the daily press as a verb meaning to legally execute by electrical energy. Anything would be better than "electrocute," which is a verbal monstrosity, and we are in hearty sympathy with the *Brooklyn Eagle* and other newspapers that are waging war against this uncouth interloper in the English language. But it is hardly probable that the *Herald* correspondent's suggestion will be a serious competitor for favor, as there are objections to the proposed word, considered either etymologically or euphoniously. Who will propose a suitable and correct term?

THE latest advices concerning the Pacific cable project are favorable to the English scheme. Dispatches from Washington indicate that the agents of the enterprise are busy there. Mr. Hastings of the Hawaiian Legation called upon Senator Morgan recently and informed him that the English were making progress with their project of laying a cable from British Columbia to their colonies in New Zealand, and that the cable would doubtless touch the Sandwich Islands. The people there, he said, would greatly prefer that the cable should be connected with the United States, as that is where the greatest interest lies, but there being no evidence of any intention on the part of this country or any of its people to engage in that enterprise, the English line will be used. Of course, no exclusive right to land the cable on Hawaiian soil will be granted.

ACCORDING to reports from St. Louis, the municipal conduit scheme in that city has not received the cordial support that its promoters anticipated, and as a result it is quite likely the several electrical interests will establish independent conduit systems. There will be a good deal of underground work in St. Louis during the next few years, and the electrical companies, as well as the people, will suffer much inconvenience during the progress of the improvement. But there is no doubt that the city will be better for the change and that it will eventually prove an advantage to the companies, though it would certainly have been much better had the several interests been able to agree upon a system of electrical conduits, in which each company would have an interest. Under the present condition of affairs a clash is inevitable, and there is no doubt that the experience of electrical companies in New York, Chicago and other large cities will be repeated in St. Louis.

CONSIDERABLE freedom is shown by an electric company in criticising a decision recently given by a judge of the United States Circuit Court in a patent case in which the company was interested. The decision was adverse to the claims of the company in question and this seems to have aroused the ire of the "board of directors," for that body has issued a pamphlet addressed to the stockholders of the company in which the judge's action is severely scored. It is contended that the decision of the judge was not warranted and it is announced that the counsel for the company have advised an appeal; but the most singular part of the pamphlet is contained in the statement that the "general manager" of the company "while on a recent visit to New York, was informed by one of the defendant's counsel that they had learned from authentic sources" that the judge before whom the case had been tried "was a man who would not read the testimony, no matter how long he kept it." It seems hardly possible that such a man should occupy a seat in the United States Court. The members of that tribunal are able and distinguished jurists who have the respect and confidence of the community, and such language as that already quoted will be generally considered ill-advised and wholly unmerited.

THE influence of electricity on growing plants has been the subject of study and experiment at different times and by widely separated investigators for over one hundred years, yet very little is known of this influence with scientific exactness. Varying and perplexing results have been obtained, due largely, no doubt, to the fact that the character and strength of the current used were not carefully observed and recorded. It is possible that results of practical benefit in agriculture might be achieved if exact information on this subject were available, and it is therefore of much interest to note that Prof. D. T. MacDougal has planned a series of experiments to be carried on in the laboratory for plant physiology in the University of Minnesota. These experiments will ascertain the effect of current passing through the soil in which plants are growing, and various degrees of current will be used, from one barely perceptible by a sensitive galvanometer up to that taken from the city lighting system. In order that exact measurements and most advantageous use of the current be made, the co-operation of Prof. Shepardson has been secured, and he will personally superintend all of the electric appliances used. The results, it is hoped, will be determinative, and while purely scientific in their nature, may furnish the data from which economic experiments may be made.

APPLICATIONS for franchises in Chicago need constant attention when they are for privileges which, if granted, may make their possessors rivals of the present street railway corporations. If they are not carefully watched they are liable to be "misplaced" or they may disappear entirely. A case of this kind was brought to light in the city council at a recent meeting, when an ordinance was presented granting the Chicago General Railway company permission to construct tracks and operate electric cars on several streets on the South and West sides. This ordinance was introduced a week before by Alderman Engel and referred to the committee on streets and alleys west, of which Alderman Keats is chairman. When the committee met just before the regular meeting of the council it was discovered that the ordinance had mysteriously disappeared. No one in the city clerk's office could furnish any information concerning it. Alderman Keats examined the papers in his box carefully, but he could find no trace of the document which the committee had been summoned to consider. "I cannot surmise what became of the ordinance," said Alderman Keats. "It should have been in the box had the clerks attended faithfully to their duties. I called the committee together to consider this ordinance. As I could not find it we had to adjourn without making any report in regard to it. The petition that accompanied it had also disappeared." Applicants for future favors from that body should remember this experience and profit by it

CONNECTICUT has been the scene of many interesting events in the history of the electric railway, but the present indications promise developments in that state that will surpass everything heretofore recorded there in point of importance. The network of electric railways that now covers the state has caused the steam railroad men considerable uneasiness, and the last year has proved pretty conclusively that the trolley car is a powerful competitor in a thickly populated state like Connecticut. The people have shown a preference for the electric cars, and the steam road companies have been obliged to acknowledge their inability to hold their business in an open competition with the trolley. But the steam roads have not placed any such limitations upon their efforts. Through a powerful lobby they have gained concessions from the State Legislature, and at the present time there is under consideration legislation unfavorable to the electric lines, and consequently in the interest of the steam roads. But the trolley companies have come to realize the danger of their position, and they have already taken steps to guard their rights. Last week a meeting of representatives of electric railways throughout the state was held at New Haven. The meeting took place behind closed doors, but it is admitted that the object of the meeting was to discuss the relations of the electric and the steam roads, and to take steps toward meeting amendments passed by the Legislature so as to put the electrics on an equal footing with steam roads.

The electric companies say that they are now able to take care of themselves, and intend to do so. This will mean a fight in the Legislature between the representatives of the great corporations. There is no doubt that the management of the New York, New Haven & Hartford road is thoroughly alarmed over the progress that the trolley lines have made, and the effect upon the steam roads' business is too apparent to be denied. The consolidated lines have controlled all the business of the state until the electric companies began to cut into their territory. At present the electric lines practically parallel the steam companies' lines from Hartford to New York. There are only a few breaks in the chain and these could be easily supplied if a syndicate were to take the matter in hand. It is this contingency that the managers of the steam company fear, for they realize that such a system would prove a powerful competitor.

## Resonance Analysis of Alternating and Polyphase Currents.[1]

PROF. ANTHONY: I never could see any reason why the rotary field should be distorted or irregular. It seems to me that all these statements that there was an irregularity in the rotary field were based upon the idea that the two quarter-phase vibrations were compounded in a straight line, just as though we had a vibration following along there, and another following along in the same way. But here we have two vibrations at right angles to each other. Here is a vibration in the horizontal plane and another in the vertical plane, and exactly as in the two tuning forks we ought to get a perfect circle, not a complicated vibration, but the compound vibration ought to continually change its angle and remain constant.

MR. STEINMETZ: I think the cause of this discrepancy between the different kinds of higher harmonics, those produced by the generator and those produced by the transformer, is the fact that the ones are higher harmonics of the electromotive force, the others higher harmonics of the current. Thus the higher harmonics of the generator wave are higher harmonics of the electromotive force, and follow the laws of electromotive forces, while the others do not follow these laws, not being electromotive forces. This explains quite a number and probably most of the differences between the one and the other.

The wave of the alternating current generator may be nearly a sine-wave, may be distorted from sine shape due to the shape of the magnetic field in the alternator and so on. This distorted wave of electromotive force can be dissolved into a fundamental sine-wave and a number of higher harmonics of frequencies, triple, quintuple, and so on. These different components will follow the same law. We have in the circuit resistance, inductance and capacity, and according to the conditions of the circuit these various harmonics will be affected.

Take a non-inductive circuit; the current will be proportional to the electromotive force, and in the wave of the current all the various harmonics of the electromotive force will show up in the same proportion. The harmonics of the generator are transformed by the transformer, whose magnetism depends upon the impressed electromotive force, and closely follows its variations. Thus these higher harmonics of electromotive force reappear in the secondary.

Take the case of an inductive resistance, that is, of an induction motor or some apparatus like this: In an inductive resistance a current will flow which is less than corresponds to the true ohmic resistance, due to the counter electromotive force of self-induction. The reactance of self-induction, however, is proportional to the frequency, consequently three times as large for the triple, and five times as large for the quintuple harmonic. Thus the wave of current produced by the multiple harmonic of the generator no longer shows these higher harmonics in the same proportion. It shows them in a decreased manner—a decrease due to the effect of self induction. Thus, if you have a motor in the secondary of the transformer, the motor circuit will not show the harmonic any more, or at least not in the same strengths as the generator on a non-inductive resistance.

It is different with a condenser in the circuit. In a condenser the current is proportional to the electromotive force and the frequency; consequently it would be higher for these higher harmonics.

In other words with a condenser in the circuit of a generator, whose electromotive force wave contains higher harmonics, the current wave will show these harmonics accentuated, while in an inductive circuit they will be more or less suppressed in the current wave, and pass unaffected in a non-inductive circuit. You see that you can get all kinds of phenomena, according to the relative proportion of non-inductive resistance, inductance and capacity. But still you always get the same thing; different electromotive force waves acting upon the same circuit, and the current produced by these waves independently superimposed upon each other to the resultant current.

It is quite different with the second class of harmonics, the higher harmonics of current.

If on a transformer a sine-wave of electromotive force is impressed, the magnetism must be a sine-wave also, if the impedance is negligible, because the counter electromotive force being equal to the impressed electromotive force but opposite, and equal to the change of magnetism, requires that the magnetism be a sine-wave. If the electromotive force is a sine-wave, the current can not be a sine-wave, but the current must be distorted due to the effect of hysteresis, that is, due to the lack of proportionality between current and electromotive force, and this distortion of the current wave means the production of higher harmonics, and the amplitude of the higher harmonics with regard to the fundamental depends upon the difference; the lack of proportionality between current or magnetomotive force and magnetism. Thus, in an open circuit transformer, where the reluctance is nearly all air, you find the amplitude of these higher harmonics of current very much less in proportion to the fundamental than in a closed circuit transformer; or rather in a closed circuit transformer the fundamental is less, while the higher harmonic is the same as in the open circuit transformer (other things being equal), and thus the higher harmonics will more and more disappear in their relation to the fundamental by an increase in the fundamental due to open magnetic circuit or due to the increase of load on the secondary. Such cases are shown in my paper on "Hysteresis—Part III.," which I propose to read presently. You will see that this harmonic is merely produced by the necessity of the current to maintain a sine-wave of magnetism; this is a secondary phenomenon and has no "stability;" that is, no existence independent of the conditions producing it.

It is obvious that these latter higher harmonics cannot be brought to resonance like the higher harmonics of the generator electromotive force, since they are no electromotive forces at all, and only electromotive forces can be brought to resonance.

1. Discussion of paper read by M. I. Pupin, Ph. D., before the American Institute of Electrical Engineers, Philadelphia, May 18, 1891, and published in the WESTERN ELECTRICIAN July 21, 1894.

If the generator does not give a sine-wave, but a wave which contains higher harmonics, and if it feeds a transformer, which, due to the discrepancy between magnetizing current and magnetism, gives higher harmonics also, you get a circuit containing higher harmonics of electromotive force and higher harmonics of current, which according to the circumstances may either aid or oppose each other.

The experiment showing that the hysteresis does not cause any distortion in the alternator armature proves nothing, because it is quite possible that there is no hysteresis in the armature of the generator. There is a waste of energy by molecular magnetic friction; but molecular magnetic friction is not identical with hysteresis as I have shown in my second paper on hysteresis.[1] Magnetic hysteresis is the disproportionality between magnetomotive force and magnetism, as the name signifies, and this disproportionality is produced if upon the alternating magnetic circuit no external energy is expended, since energy is consumed in the circuit by the molecular magnetic friction, which energy must be supplied from somewhere, and in the absence of any other source of energy is supplied by the magnetomotive force in the form of magnetic hysteresis. But this energy may be supplied by mechanical energy, and this is the case in the smooth core machine, and thus we may not find any hysteresis, any disproportionality between magnetic field strength and magnetomotive force.

In a transformer the iron core is indeed set in vibration by the alternating magnetism, but this vibration cannot supply the energy consumed by molecular friction, and thus cannot eliminate hysteresis, because this vibration is produced by the alternating magnetomotive force and has the effect of intensifying the loss of energy—increasing the area of the hysteretic loop by the loss of energy in mechanical vibration, thus intensifying the higher harmonics, since now energy is expended not only by molecular magnetic friction, but also by mechanical vibration. Proof of this increase of hysteresis by mechanical vibration due to the alternation of the magnetism I have also shown in my second paper on hysteresis.[2]

With regard to the ratio of the amplitude of the higher harmonics to the fundamental, I have in the paper which I propose to read a number of such higher harmonics construed from theoretical reasons from the cycle of hysteresis, but I do not find a strict proportionality. It is proportional within a very limited range only, and I believe the exact proportionality which Prof. Pupin found is due to this very limited range of magnetization used in his experiments. So far as I understand he used densities up to $B = 4{,}000$ only. But the proportion changes very much when you go higher. I had a chance to go very high—to go to $B > 20{,}000$. But I found that at these densities the higher harmonics are so enormous that occasionally they obscure the fundamental altogether. You get this effect if you take a transformer built for 125 cycles and 50 volts and run this transformer at 25 cycles and 100 volts, whereby the effective magnetization will go up beyond $B = 25{,}000$. Then the exciting current gets enormous and gets utterly distorted and you can just detect that there is a fundamental left, but the most of the current is higher harmonics.

With regard to this much discussed phenomenon of resonance, let us see what it really means, and whether it is a separate phenomenon at all or merely a special case of a well-known phenomenon.

You know that if you insert in an alternating circuit a self-induction, the self-induction will consume an electromotive force lagging behind the impressed electromotive force by 90° or a quarter period. The resistance will consume an electromotive force in opposition to the impressed electromotive force; and a condenser inserted in the circuit will take a current leading 90°.

Now consider what takes place if you have a circuit closed by a condenser, that is, a circuit whose current leads the electromotive force by 90°, or a quarter period, and have in series with that condenser self-induction.

By self-induction a counter electromotive force is induced which lags 90° behind the current. But the current is 90° ahead of the impressed electromotive force. Thus, the counter electromotive force of self-induction is in phase with the impressed electromotive force and adds itself thereto. Hence the effective electromotive force is increased by the self-induction being brought into phase with the impressed electromotive force, and if this increase is excessive we call it "resonance," but it is nothing different from the action of the choking coil which produces a counter electromotive force 90° behind the current and thereby, according to the phase relation between current and impressed electromotive force, either reduces the electromotive force, if the current is lagging, or increases the electromotive force if the current is leading.

Thus, if you take a condenser with an impressed electromotive force of say 100 volts, and suppose the condenser takes 10 amperes. Now insert a self-induction which with 10 amperes current will produce a counter electromotive force of 100 volts; this counter electromotive force of 100 volts is now due to the lead of the current, in phase with the impressed 100 volts, adds itself thereto and thus gives 200 volts at the condenser terminals, with 100 volts impressed at the generator. These 200 volts will double the current and you get 20 amperes through. These 20 amperes will induce a counter electromotive force of self-induction of 200 volts. Then you get 400 volts at the condenser terminals. That means 40 amperes and 400 volts at the self-induction. So you see that the self-induction in series will raise the condenser electromotive force infinitely, that is, until the increase of current causes the resistance to consume the total impressed electromotive force.

You see it is nothing but our well-known old friend self-induction introducing an electromotive force lagging 90° behind the current and thereby affecting the impressed electromotive force according to the phase relation of the current.

MR. KENNELLY: While this paper appears to give us valuable information concerning an important method of analysis of alternating electromotive forces and currents, it also generally attacks Fleming's theory of distortion of the current wave in alternating current circuits, and I beg to submit that in spite of all that has been said in this paper, and without impugning in any way any of the observations recorded there, the evidence is not in any way conclusive that the existing theory is wrong. I do not mean to say that the existing theory is right, because I hope it is not. I hope it is so far incomplete that there is much more to learn. But it is one thing to say a theory is right, and another to say it is wrong, and I do not think that the evidence here is at all conclusive that the theory is wrong, partly for reasons brought up by Mr. Steinmetz, and partly for the reason that the beautiful method employed by Dr. Pupin is necessarily and fundamentally weak in one great important particular, namely, that while it brings out the harmonic in any periodic current of electromotive force, it does not bring out, and cannot bring out, the phase relations of those harmonics, and that consequently you can have a large harmonic in an alternating current electromotive force or current strength, and the shifting of its phase will produce an enormous difference in the shape of the wave, whether it is in step with the fundamental or whether it is not in step, and as you shift it along, the consequences which will be produced on the shape, and on the results of that shape, may be so great as to totally defeat the conclusions that you would base on your observations.

1. *Transactions*, vol ix., pp. 7 12-716.
2. *Transactions*, vol. ix., p. 715.

DR. PUPIN: I think that I have distinctly referred to an experiment which met the objection of Mr. Kennelly, and that is that the phase relations had nothing to do with the amplitude of the harmonics, as determined in my investigations. No more than it makes any difference in the analysis of acoustic vibrations by means of Helmholtz's resonators, whether the phase relations between the various harmonic components of a complex sound he this or that. As mentioned in my paper, we really care very little for the exact shape of the alternating current wave. What we want is the relative value of the amplitude of the harmonics, and we do not even care whether these harmonics be in phase with the fundamental or not, provided that phase directions will not affect our results, and experiment has shown that they do not.

I have not attacked Prof. Fleming's theory of the generation of harmonics by hysteresis. I brought facts which seem to me to be difficult to reconcile with the hysteresis theory of harmonics. In fact, I do not really see on what foundation rests Prof. Fleming's theory of the generation of harmonics by hysteresis. Nor do I see that there is a sufficiently strong foundation for any other theory. Every investigator, of course, has some temporary physical theory of the phenomena which he investigates; but he generally keeps it to himself as a suggestive guide. If he chooses to offer it to others it is always with a view of inducing them to test its validity. Such a theory seems to me to be Prof. Fleming's theory of the hysteretic distortion of alternating currents, and I fail to see any objection to a reasonable criticism of it. Mr. Kennelly's remarks led me to think that in his opinion Prof. Fleming's theory is beyond criticism, or that, at any rate, my criticism of it is not a reasonable one. I do not think that Mr. Kennelly's discussion of my paper can justify either one of these two views on his part.

Mr. Steinmetz states that my experiments with vibrating and otherwise mechanically disturbed cores seem only to throw some doubt on the hysteresis theory, but that in reality they do not affect it in the least. Hysteresis is affected by mechanical vibrations, according to experiments of Prof. Ewing and Prof. Ryan. Hence if hysteretical processes are affected by mechanical vibrations, and harmonics are due to a hysteretic action, then there ought to be some connection between them. That is, the harmonics being generated ought to be diminished or affected in some way by mechanical vibrations; but they are not. To get out of the way of this difficulty, Mr. Steinmetz simply states that it is not that hysteresis which is affected by mechanical vibrations that causes a distortion of an alternating current wave, but an entirely different kind of hysteresis, namely, molecular friction. A very ingenious way of arguing! But making new hypotheses in order to get out of the way of old difficulties seems to me to help matters very little. I prefer to face the difficulties and try to clear them away by experimental evidences rather than by skillful manipulation of neat hypotheses.

I am very sorry that I did not understand the rest of Mr. Steinmetz's discussion. It seemed to me that what he wished to say was to explain things that I thought were perfectly plain to everybody. We all know that self-induction will offer a larger impedance to higher than to lower harmonics. There is nothing new in that. So far as his explanation of electrical resonance is concerned, it may be very good according to his own taste. It certainly does not suit mine. I do not think that anybody has looked upon electrical resonance as something which is outside the well-known laws and well-known phenomena. Electrical resonance is an ordinary every day affair. At any rate I always tried to represent it as such, and I am sorry that Mr. Steinmetz has not succeeded in catching my meaning. I am quite sure that I wrote a very popular paper on the subject over a year ago and am rather surprised to find Mr. Steinmetz so anxious about the possibility of having people look upon electrical resonance as something mysterious.

MR. STEINMETZ: I think Mr. Kennelly is perfectly right, because what interests us is, how high will the electromotive force go, and so it is of importance to know whether the different component waves will reach their maximum at the same time or whether they will overlap each other, so that when one is high the other is low, and that the sum total will not be increased or will even be reduced.

DR. PUPIN: I wish to correct your statement right here. If we have a certain number of frequencies and the line is in resonance with one of them, it cannot at the same time be in resonance with another. It is only in that case that we could have an overlapping of these different amplitudes.

MR. STEINMETZ. I do not think you understood me. If you have a fundamental of say 10,000 volts and superimpose a triple harmonic of 10,000 volts, you will either get 20,000 volts or you may get almost nothing if they go against each other. I mean the overlapping of the one higher harmonic, which is in resonance with the fundamental, which is already quite high.

With regard to the difference between molecular friction

and hysteresis, and the proof that these are entirely different phenomena, which have directly nothing to do with each other, I may refer to my second paper on hysteresis, where I think I brought conclusive proof of my statement and to my present paper, where I fully discuss the matter.

## New 800 Kilowatt Generator.

The General Electric company is now building at Schenectady one of the largest alternating current generators ever constructed. The machine is to be installed at St. Louis, Mo., in the station of the Edison Electric Illuminating company and will supply current for incandescent arc lighting and for motor service.

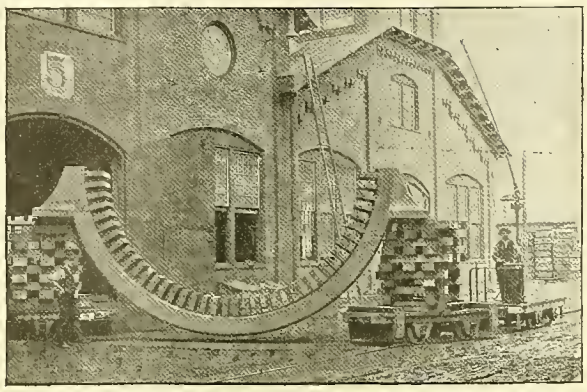

FIG. 1. NEW 800 KILOWATT GENERATOR.

In order to secure efficient results for these various uses, the generator is constructed on the monocyclic system recently adopted by the General Electric company. This system employs a comparatively low frequency of alternations, and the armatures of the generators have special windings adapting them for use on circuits with self-starting current motors.

The generator illustrated is of 800 kilowatt capacity, has 80 poles and is to be driven by a Hamilton-Corliss engine at 90 revolutions per minute.

On account of the great size of the frame, difficulties were to be expected in producing the castings, but thanks to the facilities of the Schenectady works no trouble was experienced in pouring even the large frame casting shown, Fig. 1. This single piece made up in part of wrought iron embedded in the casting weighs 35 tons and measures 24 feet over all. The armature is ironclad and is 16 feet in diameter, weighing nearly 100,000 pounds. The armature will be supported on a 22 inch shaft.

Fig. 2 shows also the armature spider before the laminations were placed upon it. An idea of its size may be had by comparing the spider with the 400 kilowatt rotary converter which stands to the right of it.

The completed generator will supply when at full load 667 amperes at 1,200 volts, equivalent to 16,000 16 candle power lamps.

In this connection it should be stated that the great size of the generator was necessitated by the requirements under which the machine is to be operated, chief of which is the low speed of revolution.

| AMP. FT. V. loss | | SIZE B & S. G. | AMP. FT. V loss | |
|---|---|---|---|---|
| 50 | | 500 | 500 | |
| 40 | | 400 | 400 | |
| 32 | 000 | 320 | 320 | 000 |
| 25 | | 250 | 250 | |
| 20 | | 0000 | 200 | |
| 16 | 000 | 000 | 160 | 000 |
| 12 | 5 | 00 | 125 | |
| 10 | | 0 | 100 | |
| 8 | 000 | 1 | 80 | 000 |
| 6 | 4 | 2 | 64 | |
| 5 | | 3 | 50 | |
| 4 | 000 | 4 | 40 | 000 |
| 3 | 2 | 5 | 32 | |
| 2 | 5 | 6 | 25 | |
| 2 | 000 | 7 | 20 | 000 |
| 1 | 6 | 8 | 16 | |
| 1 | 25 | 9 | 12 | 5 |
| 1 | 000 | 10 | 10 | 000 |
| | 8 | 11 | 8 | |
| | 64 | 12 | 6 | 4 |
| | 500 | 13 | 5 | 000 |
| | 4 | 14 | 4 | |
| | 32 | 15 | 3 | 2 |
| | 250 | 16 | 2 | 500 |
| | 2 | 17 | 2 | |
| | 16 | 18 | 1 | 6 |
| | 125 | 19 | 1 | 250 |
| | 100 | 20 | 1 | |
| | 80 | | | 8 |
| | 64 | | | 640 |

WIRING CALCULATOR.
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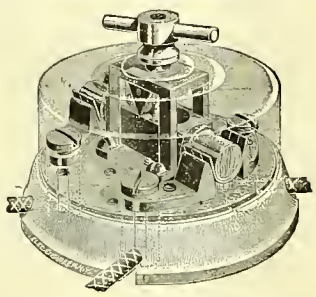
ROBERTS' SLIDE RULE WIRING CALCULATOR.

## New England Switch.

An excellent idea of the construction and operation of the New England switch can be gained from an inspection of the accompanying cut. It is manufactured by O. S. Platt of Bridgeport, Conn., and is made of the best material throughout. It is strong, neat in appearance, and simple in construction, and is claimed to be the most durable switch on the market.

The contacts consist of copper brushes, for high conductivity, backed up by German silver for spring qualities, and being forced down and held firmly between the contact lugs by the cam, makes the best possible contact—and it is impossible to liberate them without turning the handle.



NEW ENGLAND SWITCH.

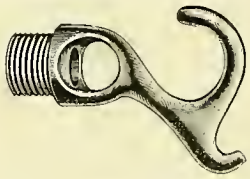
This switch is accepted by electrical engineers throughout the country, and is giving the best of satisfaction wherever it is used. Being on the knife switch principle, it is approved by underwriters.

The stockholders of the Raleigh, N. C., Electric company have decided to authorize an issue of $25,000 of first mortgage bonds for the purchase and installation of their electric light plant and to improve and enlarge the railway equipment.

## Gas Fixture Attachment and Socket Hooks.

The Independent Electric company of Chicago is placing on the market a new lamp fixture attachment, which is illustrated herewith. This article seems to have several specially good points and is known by the name of "Universal." It can be readily and permanently attached to gas fixtures without breaking the gas joint, which is a very desirable feature. It is also very flexible and at the same time strong. Having no soldered joints there is no danger to the lamp even if fitted with a heavy shade. The appearance of this attachment is also in its favor, and there is no doubt that it will meet with good success.

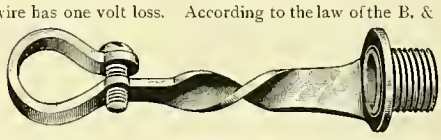
The above company makes a full line of this class of goods, including socket hooks, both single and double, such as illustrated herewith.



GAS FIXTURE ATTACHMENT AND SOCKET HOOKS.

## Roberts' Slide Rule Wiring Calculator.

This slide rule is designed by Prof. E. P. Roberts of the Correspondence School of Technology, Cleveland, O., and its action is readily understood. The scale, as shown in the illustration, consists of a central portion which can be moved relative to the other portion. On the sliding portion is printed the various size wires of the B. & S. gauge, and on the right and left are columns giving ampere feet and volt loss. The starting point in the design of the scale is in the position illustrated. It will be noted that No. 10 wire is in line with 1,000 on the left. As No. 10 wire has one ohm resistance per thousand feet, evidently 1,000 ampere feet of No. 10 wire has one volt loss. According to the law of the B. & S. gange, No. 7 wire is twice the size of No. 10, therefore it will carry 2,000 ampere feet and have one volt loss. No. 4 again doubles, and therefore carries 4,000 ampere feet for one volt loss. Again, if the slide be drawn so that No. 7 is opposite 1,000, then we have twice the size wire we had before for each given number of ampere feet, therefore we should have one-half a volt loss. It will be found that when 7 is opposite 1,000 the arrow is opposite 500; only the portion to the left of the vertical line gives volts, and therefore the 5 is really .5, as the verdical line acts as a decimal point.



GAS FIXTURE ATTACHMENT AND SOCKET HOOKS.

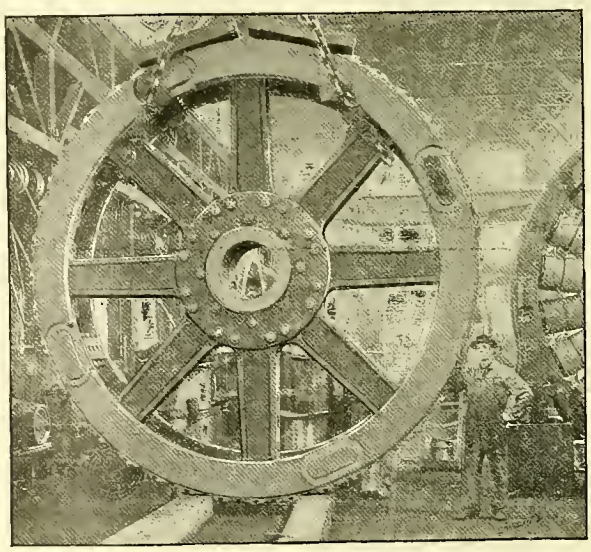


FIG. 2. NEW 800 KILOWATT GENERATOR.

Returning the slide to its original position it will be noted that on the right we have 10,000 in line with No. 10; evidently, if we have one volt loss for 1,000 ampere feet of No. 10, there will 10 volts for 10,000 ampere feet. This gives the starting point for the right-hand column and the other figures are obtained as before.

When the arrow heads are in line the right hand figures represent not only ampere feet but circular mils. This is

because No. 10 wire is 1 inch in diameter and has 1,000 (approximate) circular mils. The approximation is close enough for all practical purposes. Therefore, the area being obtainable, the equivalent of cable, etc., is readily determined.

On the back of the scale is printed carrying capacity and examples of use.

In use, all that is necessary is to place the arrow head opposite the volts loss desired, and the proper size of wire is found in line with the ampere feet. Lamp feet can be used if preferred.

## Degenhardt Memorial Meeting.

On Sunday afternoon, December 16th, a number of friends of the late Fred E. Degenhardt assembled at the Union League Club, Chicago, to pay a tribute to the memory of their departed friend. There was an excellent attendance, although notice of the meeting had been issued only the day before, and those who responded represented every branch of the business. F. S. Terry called the meeting to order and upon his suggestion B. E. Sunny was chosen chairman. Mr. Terry was named as secretary. In opening the exercises Mr. Sunny referred feelingly to the event that had led to the meeting. He spoke of the great loss that had been sustained by the death of Mr. Degenhardt. He said that it had seemed fitting to call the present meeting to take such action as would be deemed appropriate. Mr. Sunny also referred to the active part that Mr. Degenhardt had taken in the development of the different branches of the electrical industry, especially his work in connection with the perfection of underground telephone cables. Mr. Sunny also spoke of Mr. Degenhardt's sterling character and genial disposition. His death was a great and personal loss to all who knew him.

Upon suggestion of F. W. Parker the chairman was authorized to appoint a committee to prepare a suitable memorial, and report to the meeting. The committee, comprising Messrs. Parker, Kreidler and Young, withdrew for consultation, and during their absence addresses were made by several of the gentlemen present. The committee reported the following resolutions, which were unanimously adopted by a rising vote:

WHEREAS, It has pleased an all-wise Providence to remove from among us our cherished friend, Frederick E. Degenhardt, who passed away on the 7th of December, 1894; and,

WHEREAS, We, the friends of Mr. Degenhardt who are engaged in electrical pursuits, desire to voice, as best we may, our deep grief at the demise of our fellow worker, and our sympathy for his family; therefore,

*Resolved*, That we inscribe our names to the following testimonial:

We who met our late friend in the activities of business life had ample opportunity of judging his sterling qualities as a man. We knew him to be keen and diligent in business, an honorable competitor and a model of integrity in all his dealings with his fellow-men. In every sense Mr. Degenhardt was a manly man.

He endeared himself to us all by his ready wit and abundant good spirits. He had a cheery word for his associates at all times, and the electrical fraternity of Chicago numbered no more popular member than he. To meet him was always a pleasure, and we now recall with fond regret the bright incidents of our acquaintanceship with him.

He was singularly happy in his domestic relations, a loving husband, an affectionate father and a devoted son.

Successful and well liked in business, happy in his home and in the prime of a vigorous manhood, the sudden death of Frederick E. Degenhardt comes as a sad mystery and a great calamity to us all.

*Resolved*, That we tender to the surviving members of Mr. Degenhardt's family assurance of our most sincere sympathy. We share their grief and mourn with them.

*Resolved*, That these resolutions be published and that an engrossed copy be given to the family of our friend.

The committee was instructed to have the resolutions engrossed and presented to the family, and upon motion F. S. Terry was added to this committee.

A letter was read from F. G. Beach, regretting his necessary absence and asking that he be allowed to endorse the expressions of regard for the memory of Mr. Degenhardt, and of condolence and heartfelt sympathy for his bereaved family.

During the meeting the following named gentlemen made short speeches, in which they testified their grief at the untimely end of their departed friend and their sympathy for those whom he had left behind:

Charles H. Wilson, F. W. Parker, Chas. E. Gregory, Ben. Williams, E. B. Chandler, J. B. O'Hara, A. S. Terry, W. E. Keily, W. A. Kreidler, J. P. Barrett, F. S. Terry, James W. Johnson, H. P. Lucas, J. C. Kenney, S. F. B. Morse, J. B. Carney, Frank C. Stover, John Young.

Mr. Sunny suggested preparing a memorial, containing a likeness of Mr. Degenhardt, together with the resolutions adopted at the meeting and such other matter as seemed appropriate, and upon motion of Mr. Wilson the committee was instructed to prepare the memorial and have as many copies printed as would be required.

## The Washington Carbon Company to the Front.

A representative of the WESTERN ELECTRICIAN recently visited Pittsburg, and took the opportunity to interview President James S. Humbird of the Washington Carbon company relative to rumors which have been afloat concerning recent improvements in the product of his factory.

As has been well known to newspaper men, the Washington Carbon company for a long time has been working to produce a cored carbon which would compete in quality with those of foreign manufacture. Several times the company's experts were under the impression that they had produced an article which would be up to the standard and compete with the cored carbons from the other side of the water, but more extensive tests showed that the goods were not up to the high standard desired by the Washington company. But after repeated trials, which met with more or less success, they have now ready for the market a cored carbon, which is called "Helios." This carbon, the company claims, is made precisely as abroad, and is conceded, by all who have tried it, to be a remarkably fine carbon.

It might be mentioned here, relative to the name "Helios," that the Washington Carbon company has arranged with the Helios Electric company of Philadelphia to use the trade name "Helios" as applied to carbons; in fact, the Helios company has assigned this right to the Washington Carbon company.

Mr. Humbird further stated that in addition to the works at Washington, Pa., fire-proof buildings have been put up, which will be devoted exclusively to the manufacture of the "Helios" cored carbon for both alternating and direct currents.

In closing the interview, Mr. Humbird, in reply to the question as to whether he could give the WESTERN ELECTRICIAN an exclusive bit of news, said: "The Washington Carbon company has not been working for nothing, and very shortly we will have something entirely new for series arc lighting."

"What's its nature?" was asked.

"Well, never mind that, but I would advise electric lighting companies to go slow in making new contracts."

# CORRESPONDENCE.

## New York Notes.

NEW YORK, December 15.—At this week's meeting of the Rapid Transit Commission President Orr reported for the committee appointed two weeks ago to confer with the officials of the New York and Harlem railroad and its lessees regarding the interferences which would have to be adjusted between that company and the commission, in case the East Side route up Park avenue, suggested by Mr. Parsons, was adopted. The New York Central officials had appointed a committee to meet the committee of the commission. This committee consists of Chauncey M. Depew, Cornelius Vanderbilt and J. Pierpont Morgan. Mr. Orr said that the committee had met Mr. Depew and Mr. Vanderbilt at the office of the commission, and that it had been agreed that Chief Engineer Parsons should confer with Mr. Katte, chief engineer of the Central, and that these engineers should ascertain just how, and to what extent, the proposed East Side rapid transit route would conflict with the structure of the railroad.

The lighting of the city by gas and electricity for the coming year will cost $935,000. The contracts for electric lighting were awarded as follows: The Brush Electric Light company, 295 lamps at 40 cents a night and 92 lamps at 45 cents a night; the United States Illuminating company, 411 lamps at 40 cents a night; the Mount Morris Electric company, 344 lamps at 40 cents a night; the Madison Square Electric company, 299 lamps at 40 cents a night and 10 lamps at 50 cents a night; the Harlem Light company, 210 lamps at 40 cents a night and 19 lamps at 50 cents a night; the Manhattan Electric Light company, 163 lamps at 40 cents a night; the Edison Electric Illuminating company, 107 lamps at 50 cents a night; the North River Electric Light company, 827 lamps at 45 cents a night.

Articles of incorporation of the Staten Island Electric Railroad company have been filed in Albany with the secretary of state. The company proposes to construct an overhead trolley road about twenty-two miles in length between New Brighton and Edgewater and the towns of Northfield and Southfield, Richmond county. The capital is $1,250,000 and the directors are George B. H. Harvey, Milton L. Bonden, John A. Hilton, John J. Walsh, William H. Hurst, John T. Mills, Eugene R. Leland, A. J. Hummell and Henry Haggerty of this city. Nothing has yet been done toward securing franchises from the Staten Island villages, but the plans of the company have been put into such shape that this work will be prosecuted at once after the officers are elected. It is said that the men interested have plenty of capital behind them and if they receive the desired franchises, of which they have no doubt, the work of constructing the roads will go right ahead. They expect, by furnishing good transit facilities and thus opening up a vast amount of territory not now readily accessible, to attract residents to Staten Island and thus soon realize upon their investment.

From Hartford, Conn., come complaints of the obstacles thrown in the way of the improved service of the street car company. On Thursday the company opened the Lafayette street line with trolley cars and ran it for five hours, when it was ordered to stop by the Street Board of the city. The incident has brought out a great many protests on the part of citizens who have been waiting for rapid transit and are anxious that the cars shall begin running as soon as possible. The Street Board passed a resolution at its meeting on Wednesday night forbidding the railway company to start the trolley lines until it had complied with the order compelling fenders and guard wires over the trolley. The fenders have been provided, but the guard wires are not yet in place; the company, however, professes its willingness to put them up immediately. The Street Board has persistently put obstacles in the way of the work of equipment of the electric lines, and the company, having expended half a million of dollars in the equipment, is anxious to start the cars running. The people are none the less anxious, realizing that Hartford is the slowest town in New England in its street car system.

W. F. O.

## Milwaukee, Wis.

MILWAUKEE, December 15.—The Fox River interurban electric railway project is getting out of the muddle in which it has been involved. It is announced that the Wisconsin Interurban Railway company will be incorporated as soon as the necessary franchises are obtained at Neenah, Kaukauna and Menasha. The incorporators, it is announced, will be Charles H. Aldrich, ex-solicitor-general of the United States; Thomas A. Scott, a St. Louis capitalist; Judson T. Sherman of Lake Geneva, and F. C. Ratan and J. M. Thomson of Chicago. It is now the intention of the Interurban company to purchase the street railway plant of the Appleton Edison company, including the track, power house and rolling stock. The company has made arrangements for leasing one thousand additional horse power and plans are being prepared for a power house of greater capacity on the site of the present station at Appleton. It turns out that A. L. Smith, the president of the Appleton Edison company, instead of being behind another enterprise to build an interurban line in the Fox River valley, has been helping the new company to get a franchise. J. K. Tillotson, the chief promoter of the enterprise, says that the new company will have a capital stock of $1,000,000. The company has a franchise to build a road in Oshkosh and will proceed with the work at once without regard to the outcome of the attempts to get franchises in Neenah, Menasha and Kaukauna. C. E. Loss & Co., who would have built the interurban road had franchises been granted in time to allow the work to be done this year, will construct the Oskosh lines. Eight miles of the road in Oshkosh must be completed in four months according to the terms of the franchise. Mr. Thompson, one of the incorporators of the new company, has been spending a great deal of time of late in the cities through which it is proposed to build the interurban line. He got the option on the Appleton line and made a deal for a water power site. From Appleton he went to Menasha. He stated that his company had expected to get the franchises last July and that the amount of $600,000 in capital stock had been awaiting investment in the enterprise for some time. The subscribers, he added, were getting anxious. At the instance of Mr. Thompson an informal meeting of the business men of Menasha was held for the purpose of discussing the situation. Mayor Rosch presided. Thomas Reid, the editor of the leading newspaper at Appleton, appeared in behalf of the company, being actuated, he said, by purely patriotic motives, and urged the granting of the franchise. He had been assured, he said, that the work would be begun just as soon as the franchises were granted. The company's power house would be located at Appleton, where excellent water power had been obtained, and he said that Mr. Thompson has given him authority to say that the company would be prepared to furnish electric light to towns along the route at very low figures. Following Mr. Reid, John Strange and William Gilbert emphasized the desirability of having the road built. All wanted the road if it were properly constructed. The common council, however, should see that the city was protected. Frederick Heineman of Appleton said that he believed that an ordinance which corresponded to that which had been granted by the common council of Appleton would properly protect the city. M. M. Schoetz of Menasha, however, scored Mr. Tillotson, pointed out the mistakes which had been previously made and advised the council to profit by its experience. Mayor Rosch said that the council would not act hurriedly in

granting a franchise, the members preferring to take their own time and make no mistake. It seemed to be the sense of most of the people who attended the meeting that the new company should buy the old street car line, which it is willing to do, but claims that Mr. Schumacher, the owner of the line, wants an exorbitant price for the property. The route from Neenah through Menasha to Appleton was discussed. Should a franchise be granted, a new bridge across the Fox river at the Menasha dam might have to be built, and an estimate of the probable cost of the improvement is being made in order to determine the proportion of the expense that the Interurban company ought to bear. A committee consisting of J. R. Bloom, E. D. Smith, Joseph L. Fieweger, M. M. Shoetz and John Clevis was appointed to investigate Mr. Thompson and his company. Mr. Thompson also visited Neenah and Kaukauna.

The common council of Depere has granted to J. H. Elmore and Frank Van Derzee a franchise for an electric railway to connect that city with Green Bay. The franchise, however, is burdened with the provision that the two projectors of the line shall build a bridge of their own, it being claimed that the two city bridges are both too narrow, as the city will not permit the company to use the roadway. To widen either of the bridges, as has been proposed, would require an outlay of between $15,000 and $20,000. To build a new bridge would of course cost a great deal more. The friends of the project declare that the condition imposed by the common council is simply a clumsy attempt to kill the entire deal without appearing to do so. Mayor Dousman pronounced the ordinance faulty and said that he would veto it. Messrs. Elmore and Van Derzee have got the right of way from Green Bay to the city limits of Depere, and will hold it for two more years. If Depere wants to build the road as an enterprise of her own, as it has been proposed she would be compelled to take the right of way off the hands of the two men to whom she has granted such an illiberal franchise. They stand ready to invest a large sum of money in the enterprise.

The operation of the West Sixth street electric line in Racine has been inaugurated.

Superintendent Schumacher of the Racine street railway has not recovered from a shock caused by the receipt of an offer from a citizen to reimburse the company for damage to one of its cars by reason of the writer's rig colliding with it.

The city of Bayfield now has an electric lighting plant of its own, having purchased the private plant.

Surveyor Powrie of the Waukesha Beach railway denies a report that the Chicago & Northwestern Railway company would operate the line as soon as it is finished. The road, it is asserted, could not be successfully operated by steam, owing to the steep hills. The grading of the road is nearly completed and the work of tracklaying and putting up the poles will soon be commenced. The power plant will be put in under separate bids and will be owned by the company. The road will be operated about May 1st.

The Wisconsin Telephone company has just completed its long-distance circuit between this city and Green Bay. Hitherto Appleton has been the farthest northern point reached. It is expected that the circuit will soon be extended to Marinette.

There is pending in the common council of Oshkosh an ordinance to give F. L. Humes a franchise for the construction and maintenance of a telephone exchange in that city. The ordinance is identical with the one granted to the Wisconsin Automatic Telephone company a year ago. The franchise, it is proposed, shall run for twenty-one years.

The Milwaukee common council has requested City Engineer Benzenberg to prepare detailed plans and specifications for a city electric lighting plant, as well as an estimate of the cost of such a plant. A bill to allow the city to sell electric light will be introduced in the Legislature.

The Milwaukee-Wauwatosa electric cars now make the round trip in eighty minutes. C.

## Northwestern Notations.

MINNEAPOLIS, December 15.—The Winona Electrical company, Winona, Minn., has filed articles of incorporation.

A company has been formed at Dayton, Wash., to construct an electric light system.

The citizens of Rainy Lake City, Minn., the location of the gold discoveries, are agitating for a telephone line to Tower, Minn., 100 miles. The cost is estimated at $2,500, and Fort Francis, Koochiching and the Seine River country are expected to assist in its construction. The Harrison Telephone company is canvassing Davenport, Ia., and Rock Island, Ill., with a view to putting in exchanges.

The city clerk of Missoula, Mont., advertises for bids to furnish from 20 to 25 arc lamps of 1,200 candle power for one, three and five years' contract, the light to burn from dusk till daylight.

Henderson, Minn., will hold another election to settle the electric light question.

It is reported that another company has secured the promise of three-fourths of the present telephone company's subscribers, to take the new service at half the rate now being paid in Minneapolis if the servive is as good. A similar project is being canvassed in St. Paul.

A syndicate has been formed to buy the South Morning Side street car line in Sioux City, Iowa, and turn it into an electric line to be run in connection with the elevated road.

The International Christian Alliance Hospital & Electric Railway company has bought the old Carney house in Emerson, Man., for its first hospital and will use electric lines as feeders to railroads on both sides of the international line.

E. Benedict and F. Potter propose to form a stock company to run a telephone line from Wadena, Minn., to Verndale, and connect with Park Rapids, Hubbard, Menahga and Sebeka.

The New Whatcom, Wash., council has referred to a committee the question of raising funds for building and equipping an electric light plant.

O. N. Bond, W. B. Smith and J. E. Crawford have applied to the Rock Island city council for a telephone exchange franchise. They are also endeavoring to start an exchange in Davenport, and Moline.

Centerville, S. D., will have an electric light system before spring.

The new telephone company which has been canvassing La Crosse, Wis., has secured sufficient subscribers to ensure the exchange being put in.

W. J. Clark, manager of the Broadwater mine, has applied for a franchise for a telephone system in Neihart, Mont.

Waukesha, Wis., business men are seeking to get an electrical appliance concern to locate there. A bonus has been offered which the company thought too low, but the town may increase it.

The $20,000 electric light plant at Oskaloosa, Ia., has burned.

The Neenah and Menasha gas and electric light plant at Menasha, Wis., has been damaged by fire about $200 worth.

A Peru, Ill., syndicate has sent a committee to examine the Rock Rapids, Ia., water works plant, with a view of purchasing it and asking for an electric light franchise.

L. L. Dutton, who fell from a pole of the Winona General Electric company of Winona, Minn., has sued the company for $8,000 damages.

The Twin City Rapid Transit company of Minneapolis and St. Paul is testing a new illuminated street car sign.

J. W. C. Morrison has filed an attachment against the Yankton, S. D., electric light plant to secure a claim of $20,000 against J. T. M. Pierce. M.

## PERSONAL.

J. W. Godfrey and Frank R. Harrington have resigned from the New York Insulated Wire company. These gentlemen are widely known to the electrical fraternity both East and West, and it is announced that Mr. Godfrey will still devote his attention to the wire business.

Martin J. Insull of Chicago was married at East Orange, N. J., on December 13th to Miss Virginia Van Vliet. The ceremony was performed by the Rev. E. W. Babcock of Stonington, Conn. The bridesmaids were Miss Luella Spellmeyer of Newark and Miss Florence Davis of East Orange. Miss Katherine Baker of East Orange was the maid of honor. George de Boketon Greene of New York was the best man, and Waldron Phœnix Belknap of New York and Fred W. Davis of East Orange were the ushers. Mr. and Mrs. Insull will reside in Chicago.

## ELECTRIC LIGHTING.

The new plant of the Osage, Iowa, Electric Light, Heat & Power company, to replace that burned several months ago, is ready for operation. The company has put a new seven-foot dam across the Cedar river two miles west of the city.

The Concord Land & Water Power company at Concord, N. H., has lately contracted for six new arc light dynamos of 75 lamps capacity, Thompson-Houston type, to be added to the plant at Sewalls Falls. It has also just set up the second 250 horse power three-phase generator for lighting, heat and power, and has re-arranged the circuits in the city, making a much more presentable appearance than formerly.

## ELECTRIC RAILWAYS.

Articles of association of a company to construct Michigan's first standard gauge electric railway have been filed. The corporation will be known as the Traverse City, Peninsula & Old Mission Electric Railway company. The capital stock is $160,000. The road will be 20 miles long and will run from Traverse City to Old Mission, via Bower's Harbor, along the east shore of the west arm of Traverse Bay. Both freight and passengers will be transported, and an outlet will be furnished for the entire fruit belt of that region. The incorporators are: J. G. Ramsdell, L. K. Gibbs, J. O. Croster, Ralph Case, J. G. Ramsdell, Anton W. Bartak, W. P. Croster, Charles Wilhelm, W. H. Foster, Elsworth Clark, Frank Votruba and Harry L. Gibbs, all of Grand Traverse county.

It is possible that Detroit may be the pioneer in the movement for lower street car fares. Mayor Pingree is greatly pleased as the result of a five years' fight against the Citizens' Street Railway company is an ordinance granting a franchise to the Detroit Street Railway company to put in a rapid transit system on many of the streets of the city to compete with the Citizens' company in some portions of the town. Vice-President Hutchins of the Citizens' company has given formal notice to the Packs and H. A. Everett that his company claimed the right to build on all the streets offered the syndicate. The thirty-year ordiance provides that all lines must be running by January 1, 1896; that seven tickets be sold for a quarter, except that from 10 P. M. until 5 A. M. six tickets shall be sold for a quarter; general transfers over the company's lines; the city to do the paving between the tracks and keep it clean; the company to pay regular tax on property.

A press dispatch from Pittsburg, December 14th, says that an all-night electric car on the Duquesne line of the Pittsburg Traction company was held up at Oakland early in the morning, and the passengers were robbed. The car left Wood street in the down-town portion of the city at one o'clock. It was crowded, and made a fast run to Oakland. Here there remained in the car a man and three women accompanied by another man. Near the entrance to Schenley Park three masked men jumped on the rear platform. The conductor was thrown down and his pockets rifled while the car went at full speed. One man guarded the conductor and the others went through the car with drawn revolvers. Two of the women fainted. The passengers were robbed of their money and jewelry. At Craig street the three men left the car and the conductor notified the corner policeman. The street car company officials deny the story, and claim it is founded upon the picking of a conductor's pocket The police also pooh-pooh the story, but are understood to be working on the case, as the Duquesne company may be the defendant in heavy damage suits, instituted by the robbed passengers.

## ELECTRIC MINING.

A new colliery which is just being opened under American proprietary anspices near Eckington, Derbyshire, will serve as practical example of the utilization of electric energy. Chandos Pole is the owner of the colliery, which is to be lighted and worked entirely by electricity. High pressure boilers with high speed steam engines will be put down with suitable dynamo and motor plant. The under cutting of coal will be done entirely by electric coal-cutting machines of the latest design, and the ventilating fans will be driven by separate motors of their own.

## TELEPHONE.

Suit has been begun in the United States Circuit Court at Chicago involving the right to the use of recent telephone improvements. The complainant is the Western Telephone Construction company and the defendants Andrew Carlson and Alfred Stromberg of the Stromberg & Carlson Telephone company, Chicago. The defendants are the patentees of two telephone devices, one increasing the power of the receiver and simplifying the signal bell and the other a switch on the receiver, both of which are used conjointly. On October 21st Stromberg and Carlson sold the right to the patents to the Western Telephone Construction company, which alleges that the defendants are manufacturing and selling telephones equipped with the new devices.

Druggists and doctors of Englewood, Chicago, have been victims recently of a gang of thieves and robbers. This was the scheme: A druggist was notified late at night by telephone that a fire was raging somewhere in the down-town district and asking him to inform a neighbor said to be interested. When the druggist ran out on his supposed errand of mercy he was either held up or his store entered and looted in his absence. In the case of the doctors a notification was sent in that some one was dying not far away, and when the doctor hurried out he was promptly sandbagged. When this had happened several times word was passed around and the practice was partly broken off. The police are also watching the matter closely.

The Birmingham, Ala., *News* says: Conversation is now going on between this city and Memphis, Tenn. The medium is the long-distance telephone of L. M. Ericsson & Co. of Stockholm, Sweden. The patents are owned in Sweden by the inventors, who are connected with the firm named. The owners have resolved to introduce the telephone into this country, and it was in accordance with this intention that the experiment between Memphis and Birmingham was introduced. It is the first trial of the telephone on this side of the Atlantic. The connection at this end was made in the office of the Postal Telegraph company. Conversation was had with Memphis with some ease, although the distance is 380 miles. A *News* reporter and others talked through the instrument with satisfaction.

## TELEGRAPH.

A dispatch from San Francisco, dated December 7th, says: The Western Union Telegraph company has appealed from the decision of the United States Circuit Court for the Southern District of California in the case of the Western Union Telegraph company against the Postal Telegraph company. The suit was decided in favor of the Postal in the lower court. It involves the construction act of congress by which the Atlantic & Pacific railway received its franchises. The railway company tried to grant exclusive rights to the Western Union, but the court held that the Postal had equal rights.

## MISCELLANEOUS.

The horse is easily killed by electricity. It is popularly supposed that the current, on entering the body, meets with some physiological susceptibility that makes this animal more vulnerable than others to the action of such a current. The London *Lancet* holds that there is no good ground

for this assumptioo. The explanation lies elsewhere. The hoof, and more particularly its crust and sole, is a good insulator, but the shoe presents to the ground a large metallic contact, and this contact is in connection with metallic conductors in the shape of nails, which pierce the strongest part of the insulatioo and afford an easy electrical path into the body. The contact with earth is further improved by the great superincumbent weight of the animal, and it may often happen that in passing over wet ground the external surface of the hoof and the wet fetlock, especially in the case of untrimmed horses, may become sufficiently wet to form a good surface conductor, and so carry a current directly from the earth to the upper part of the body. In this way the safety of the natural "resistance" of the hoofs is neutralized. A horse, too, covers more ground than a man and runs greater risk from being in contact with points of ground farther apart. Horseshoers ought to bestow extra care upon the driving of the nail, to see that it does not penetrate to the "quick."

## TRADE NEWS.

The Standard Underground Cable company of Pittsburg has been deprived of its western manager by the lamentable death of Fred E. Degenhardt, but the Chicago office will still remain at 542 Rookery. F. S. Viele, superintendent of construction for the western department, will be in charge for the present.

The latest catalogue issued by the Electric Engineering & Supply company of Syracuse, N. Y., is complete and comprehensive. Railway, lighting and all other kinds of supplies are discribed in this work. The company has an excellent reputation for workmanship and first-class material in all its products, and to judge from the appearance of the last catalogue it is the intention of the managment to keep up to the standard already established.

The clothing factory of the Charles R. Lewis Clothing company, Belleville, Ill., has been equipped with a 30 kilowatt Mather generator for supplying light and power throughout the building. Electric heating irons are also used. One engine drives the generator and also the elevator. Exhaust steam is used for heating purposes. The building is a four-story brick factory building formerly used for other purposes. The factory occupies the fourth floor, while the other floors are used for store rooms, offices and power plant.

The Clonbrock Steam Boiler company of Brooklyn, N. Y., reports that the last year has been the largest in its business, its factories having been kept working over time all the while to keep pace with the orders. The company is now building an addition to its already large works to meet the rapid growth of the business. A recent order that will reach 4,000 horse power was sold to the Cleveland Electric Illuminating company of Cleveland, O. The total shipment will be thirty cars and the weight 500 tons. The first installment of this order, twelve cars, was sent last week. The Terre Haute Electric Railway company of Terre Haute, Ind., has purchased two 500 horse power boilers recently, and the Merrimac Manufacturing company of Lowell, Mass., has placed an order for four 1,000 horse power generators. The business will continue in the charge of Thomas J. Lawler, who is known far and wide to the manufacturing interests, while the office and financial management will be in the hands of S. V. Morrin, who, although a young man, has demonstrated his ability, and the practical knowledge gained by him in working up from the bottom to his present responsible position will prove of service to the company.

## BUSINESS.

The Washington Electric company's annunciators continue to be in great demand. The shops at 201–207 South Canal street, Chicago, present a scene of activity that demonstrates that this company is achieving a gratifying degree of success in its bid for business.

Linton & Southwick of Worcester, Mass., have issued a complete catalogue and price-list of their station switches and apparatus. This firm makes a specialty of this class of work, employs skilled labor, and manufactures in large quantities, and is therefore able to assure its customers that they will obtain thoroughly good and reliable work and materials at a reasonable price. No switch is allowed to leave the factory as to which there is any question.

The Naugatuck Malleable Iron company at Naugatuck, Conn., has placed the contract for its new annealing room with the Berlin Iron Bridge company of East Berlin, Conn. The building will be 94 feet wide and 175 feet long, constructed entirely of fire-proof construction The Berlin company is building a new gas house roof for the Massachusetts reformatory at Concord, Mass.; and the same company is furnishing the iron work for the new office building of the Pope Manufacturing company of Hartford, Conn.

The Mather Electric company of Manchester, Conn., has just been awarded, through its New York contractors, H. B. Coho & Co., the contract for three 100 kilowatt direct-connected generators of the new type, for the lighting plant of the new Congressional Library building at Washington, D. C. Very extensive tests of this new apparatus were made by government experts at the Manchester factory, and the adoption of this apparatus by the United States government reflects great credit on the Mather Electric company.

The Elwell-Parker Electric company of America has issued a very handsome catalogue, showing several machines manufactured by this company. The Elwell-Parker dynamos, motors and electrical apparatus have a high reputation in Great Britain and all parts of the world, and the Elwell-Parker Electric company of America, in placing these machines on the American market, is sure that they will at once take the same high position in this country. This company announces that it will be glad to furnish further particulars and detailed estimates on application.

E. S. Ford and S. J. Smith, under the firm name of Ford & Smith, have opened an office at 48 Wade building, Cleveland, O., as contracting engineers for electrical plants. They are prepared to install lighting and power plants of any size, and will undertake any kind of electrical construction or repair work. Mr. Ford was secretary of the Ford-Washburn Storelecto company for three years, and Mr. Smith, who is a practical engineer, was for two years secretary of the Brightman Stoker company. Both are well acquainted in electrical and mechanical circles.

The American Electric Supply company of Buffalo, N. Y., has severed its agency relations with the Interior Conduit & Insulation company of New York. The American Electric Supply company is one of the oldest agents of the Conduit company and the relations between the two companies have always been of the pleasantest character. The Conduit company, however, announces that it has found that its interests are antagonized when represented by a construction house and has consequently changed its policy and in the future will be represented by supply houses not engaged or financially interested in the construction business. The American Electric Supply company could not afford to give up the large construction business it enjoys, and hence followed a friendly termination of its agency relations with the Interior Conduit & Insulation company.

The increase in electrical business now being done by the General Electric company has necessitated an extension of the already extensive facilities at Schenectady, and two large buildings are now being constructed by Grattan & Jennings. One of these is a storehouse, 353 feet long and 52 feet wide. The foundations are already laid and the superstructure is rising rapidly. This will relieve the smaller storehouses, now found entirely inadequate. The other building will be used as a laboratory for standardizing. It will be erected on the very outskirts of the tract of land owned by the company at Schenectady, in order that it may be as far away as possible from the disturbing influences of moving iron and heavy electric currents in and around the many buildings of the plant proper. This laboratory will contain all the standard instruments of the company, and with these the working instruments, which are in use throughout the factories for testing purposes, will be compared each day.

The announcement is made officially that the Electric Storage Battery company, Philadelphia, has acquired all the patents and patent rights for the manufacture of electric storage batteries of the General Electric company, the Edison Electric Light company, the Thomson-Houston Electric company, the Brush Electric company, the Accumulator company, the Consolidated Electric Storage company and the General Electric Launch company. This arrangement, it is claimed, will give the Electric Storage Battery company exclusive control of the business in this country. The acquisition of these patents not only terminates all litigation heretofore existing, but insures the company against future attacks, as the patents acquired, together with those originally owned by the Electric Storage Battery company, cover all the known principles involved in storage batteries. The company announces that it has increased largely its cash working capital, and is fully prepared to fill all orders for storage batteries promptly. Catalogues containing full description of the several types of elements, weights, capacities, dimensions, etc., and instructions for installing and caring for batteries have been issued by the company. The headquarters will continue at 838 Drexel building, Philadelphia.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued December 11, 1894.*

530,497. Street Sign. Halsey H. Baker, Plainfield, N. J. Application filed January 22, 1894.

The third claim is for the combination with an electric lamp and its reflector of arms passing around the outer edges of the reflector, signs connected with the lower ends of such arms, a clamping ring with which the upper ends of the arms are connected, and a bracket receiving and supporting the clamping ring.

530,498. Insulator for Electric Overhead Construction. Henry P. Ball, Bridgeport, Conn. Application filed June 28, 1894.

A strain insulator is provided with a flange having one diameter of its opening greater than the other, an eye-bolt having an engaging part formed with one diameter smaller than the other, the two parts being arranged and adapted to engage when the longer diameter of the eye-bolt is transverse to the short diameter of the flange, and insulating material securing the parts together and insulating them from each other.

530,507. Controller for Electric Locomotive. John W. Darley, Jr., Baltimore, Md. Application filed November 16, 1893.

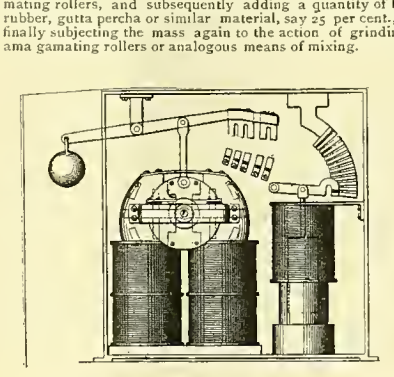
A plurality of electric motors is arranged in groups, a commutating cylinder is adapted to connect them in series or multiple, and a cut-out cylinder is arranged to cut out any disabled motor from a group in all positions of the commutating cylinder and to cut out its mate only in multiple positions, whereby the power of the mate may be employed in the series positions, while the balance of the circuit is preserved in the multiple positions.

530,516. Suppression of Self-inductive Obstruction in Electro-magnetic Apparatus. Stephen D. Field, Stockbridge, Mass. Application filed July 24, 1894.

The last claim is for an electro-magnet comprising the following elements in combination: a core capable of being magnetized, a winding or helix of two or more layers surrounding the same, and one or more incomplete inductive circuits placed in inductive relation to the said helices.

530,517. Process of Manufacturing Insulating Compositions for Electrical Purposes. Alfred N. Ford, London, Eng. Application filed June 11, 1894. Patented in England July 17, 1890.

The process described for the manufacture of insulating compositions consists first in coating or saturating certain fibrous and other substances with a drying oil which has been previously partially oxidized, and then drying these fibrous substances so treated, and, when dry, re-coating them again and again, each time drying the previous coat sufficiently to take another coat until the mass has increased in weight by such coating or saturation rom 50 to 200 per cent. approximately, and subjecting the material so treated to the action of grinding or amalgamating rollers, and subsequently adding a quantity of India rubber, gutta percha or similar material, say 25 per cent., and finally subjecting the mass again to the action of grinding or ama gamating rollers or analogous means of mixing.



NO. 530,541.

530,522. Galvanic Ring. David Hattenback, Sioux City, Ia. Application filed September 4, 1894.

A metallic ring in two parts soldered together, the metal in each part differing from that in the other part, forming in the completed ring positive and negative electrodes, is described.

530,541. Apparatus for Controlling Electric Elevators. Nils O. Lindstrom, Union Course, and Orrie P. Cummings, Brooklyn, N. Y. Application filed September 10, 1894.

The controller illustrated comprises an auxiliary electric motor having a non-commutated armature circuit, the polar axis of the armature normally lying transverse to the field of force, a controlling switch on the elevator car for reversing the direction of the armature torque, and reversing switches in the main motor circuit attached by the auxiliary motor.

530,543. Condnit Electric Railway. David Mason, Schenectady, N. Y. Application filed June 8, 1893.

The cut shows an electric railway system having one or more hollow or tubular trolley conductors held in a slitted conduit in close proximity to the surface of the road-bed, in combination with an electrical generator connected thereto, and an apparatus for forcing heated liquids, vapors or gases through the hollow or tubular conductors.

530,569. Trolley Wire Clamp. Montraville M. Wood, Chicago, Ill. Application filed July 2, 1894.

A trolley wire clamp having two jaws, each provided with projecting lugs, an interlocking pin passing through holes in the lugs, a stud bolt by which the clamp is supported, a cone shaped wedge encircling the stud bolt, a groove in each jaw for the reception of the wedge, and means for forcing the wedge into the grooves, so as to spread the jaws apart at the top and cause their clamping edges to firmly grip the t olley wire, is described.

530,575. Telephone Transmitter. Arthur F. Boardman, Somerville, Mass. Application filed August 6, 1894.

In a telephone there is an offset, an electrode, a support mounted on the offset, an adjusting screw mounted on the offset for adjusting the pressure of the electrode, consisting of a threaded shell containing a cork stopper for bearing against the electrode, and a device for locking the adjusting screw.

530,578. Electric Elevator Controller. Leroy S. Buffington, Minneapolis, Minn., and Walter C. Jones, Chicago, Ill. Application filed February 23, 1894.

An electro-magnetic device adapted to control the motive power, a switch adapted to control the operation of the electro-magnetic device, a pivoted bar, an elevator door suspended therefrom, an electro-magnetic device, an element adapted to be placed thereby in position to be engaged by the moving elevator car, and thereby to raise the end of the pivoted bar to cause the door to open, the door being adapted in its movement to actuate the switch, and switching apparatus upon the elevator car and adapted to control the second mentioned electro-magnetic device, whereby the door is automatically opened and closed, and the car is automatically brought to rest opposite a predetermined floor.

530,597. Alternating Current Transformer. Alexander W. Meston, St. Louis, Mo. Application filed January 23, 1893.

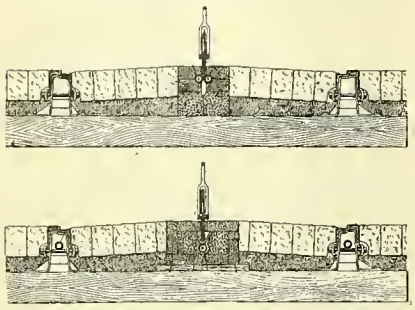
In this transformer, as sbown, the features consist of the primary coil, two segmental strips, insulated from each other, in the circuit thereof, a secondary coil provided with branch terminals, contact buttons arranged in an arc of a circle to which the terminals lead, a centrally pivoted switch for adjustably cutting in the secondary coil by its contact with the buttons, and a spring contact on the switch for maintaining electrical connection between the strips.

530,598. Telephone System. Wilhelm Oesterreich, Berlin, Germany. Application filed October 12, 1893.

The telephone system illustrated is provided with a multiple switchboard, a testing wire connected with the earth, and provided with a weak battery, a galvanometer in a branch wire, and a contact for connecting it with the circuit to be tested, and a switch provided with a depressible and oscillatory lever, operating when depressed to leave the contact and touch the contact, and operating when moved to one side to move the springs clear of the contacts and place them in contact with other conta ts.

530,619. Electtic Motor Propelled Elevator. Frank E. Herdman, Indianapolis, Ind. Application filed January 31, 1893.

Claim 1 reads: In an elevating apparatus, the combination with an electric motor provided with extra coils upon the field contacts, each contact in electrical connection with one coil, and a return wire to one of said contacts, electric connection between said contact and source of current supply, an arm adapted to pass over said contacts, electrical connection between said arm and the source of current supply, traveling sheaves lifting table wound around said sheaves and connection between said lifting cable and said arm, adapted when the strain on said lifting cable is increased beyond normal to draw said arm over said contacts.



NO. 530,543

530,637. Electric Cigar Lighter. Clyde J. Coleman, Chicago, Ill. Application filed March 24, 1894.

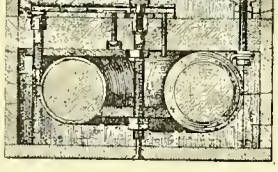
In an electric cigar lighter there is a pendent lighter casing carrying an incandescent conductor and having a weighted handle, a suspending cord attached laterally to the casing and inclosing the electric conductors, a circuit-closer consisting of closed casing arranged in a removable manner in the interior of the lighter casing, and containing a body of mercury, and contact points passing into the interior of such circuit-closer casing, so as to contact with the body of mercury when the same flows downward in such casing, in the operation of raising the lighter for use.

530,648. Fire Alarm and Annunciator System. Frederick S. Palmer, Boston, Mass. Application filed March 24, 1894.

A fire alarm system, a call system, and independent batteries for each system, two thermostats electrically united with the fire system, one thermostat being arranged to short-circuit the battery in the fire system through said system, the other thermostat to short-circuit the battery in the call system through the annunciator apparatus of the system, and through the fire system in part.

530,661. Switch for Overhead Trolley Tracks. Charles G. Schmidt, Cincinnati, O. Application filed August 13, 1894.

In a switch for overhead trolley tracks, the combination consists of the switch hinged to the main track, the branch tracks, the hangers supporting them, each provided with a support for the free swinging end of the switch to rest on when in alignment with either track, a guide bar supported by and on these hangers, which support the switch and track ends, guards carried by the guide bar and an operative connection between this latter and the switch.



NO. 530,597.

530,674. Trolley Wire and Support Therefor. Herbert H. Ashley, Springfield, Mass. Application filed August 25, 1894.

The support consists of the two parallel opposing longitudinally ranging cheek plates suitably united at and between their upper portions, whereby there is left clear between their opposite portions, at each end of the support, downwardly and endwise opening spaces, and having near such ends the slots which incline in directions downwardly and toward the middle of, and which open to the lower edges of the cheek plates, and said cheek plates having their lower edge portions continuous and unobstructed between the said slots, in combination with the trolley wires, having provided at their end portions and above the longitudinal line thereof the lateral oppositely extending projections, which are adapted to have engagements in said inclined slots, all whereby the trolley wires will be detachably supported to lie along the level of the lower edges of the said cheek plates.

530,688. Conduit Railway Trolley. Joseph C. Hawley and William J. Black, Duncannon, Pa. Application filed March 22, 1894.

The invention consists of a depending standard of the guide frame, the hand lever, the link attached thereto and the cam-shaped lever pivotally connected at its end with the link, and pivoted intermediate its ends to the standard, the cam face of the lever being adapted to bear upon the guide frame, whereby the standard is raised.

530,706. Insulator. Louis McCarthy, Boston, Mass. Application filed September 18, 1894.

An insulator comprising a metallic case has a downwardly projecting skirt with perforations therein, and a mass of insulating material applied to both the interior and exterior, as well as the edge of the skirt, and passing through the perforations, the edge portion of the skirt being embedded in the insulating material.

530,717. Brush for Dynamo-electric Machines. Edward T. Platt, Chicago, Ill. Application filed June 11, 1894.

A dynamo or other electric machine, a commutator brush provided with a flexible body portion, a contacting portion formed of a series of copper rolls having hardened steel pivots and brass-bearing portions for such roll pivots se ured to the body portion of the brush.

530,727. Rheostat. Thomas W. Shelton, St. Louis, Mo. Application filed August 20, 1894.

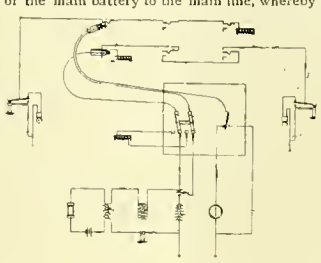
A rheostat is described, comprising a cylindrical casing provided with a vertical slot in its face, a vertical rib on the interior of its wall, a suitable cover for the casing, a series of fire-clay disks located within the casing, the disk being provided with convolute grooves in their faces and semi-circular depressions in their edges, suitable conductors embedded in convolute grooves or depressions, bolts securing the disks together in pairs, and conductors leading from the bolts to the outside of the casing.

530,748. System of Transmitting and Distributing Electrical Energy. Cummings C. Chesney, Pittsfield, Mass. Application filed April 19, 1894.

The method of transmitting and distributing electric energy, which is illustrated in the cut, consists in generating three-phase currents of low frequency and high tension; by these operating a motor, which, in turn, drives a two-phase generator adapted to yield currents of high frequency and distributing these currents to translating devices.

530,762. Electrical Block Signal Apparatus. Urias J. Fry, Milwaukee, Wis., and George M. Basford, Oak Park, Ill. Application filed July 5, 1893.

The invention consists of a system comprising a main line or circuit connecting distant stations, each of which is provided with a battery and a suitable signal, of a locking device for each signal, comprising an unlocking magnet in a local circuit with the main line battery, a polarized relay controlling the local circuit, and arranged to positively shift its armature in opposite directions when energized by currents of opposite polarity, and to automatically return the armature to its normal position when the main circuit is broken, signal transmitting and receiving instruments at each station, a switch arranged to connect either the transmitting and receiving instruments and the battery or the polarized relay of each station with the main line, and a pole-changing switch at each station arranged to reverse the poles of the main battery to the main line, whereby the entire



NO. 530,598.

energy of a single battery at each station is utilized for transmitting signals, operating the polarized relay of the distant station and unlocking the signal of the local station.

530,763. Block Signal Apparatus. Urias J. Fry, Milwaukee, Wis., and George M. Basford, Oak Park, Ill. Application filed September 17, 1894.

The first claim is for a main line or electric circuit connecting stations, each of which is provided with a signal, an electromagnetic signal-locking device and means of releasing the locking device of the distant station, of a circuit-breaker adapted to render the signal releasing means inoperative after it has been operated, a magnet controlling the circuit-breaker in a local circuit provided with two circuit-breakers, which are controlled by separate train circuits or track instruments.

530,764. Primary Battery. George H. Gardner, Boston, Mass. Application filed March 2, 1894.

In a primary battery an annular metallic contact plate is molded into the material of which the cell is composed, and having its edges overlaid by the cell material and adapted to form a metallic lining for that part of the bottom of the cell that lies between the porous cup and the walls.

530,773. Electric Motor. Frank E. Herdman, Winnetka, Ill. Application filed July 25, 1894.

An electric motor, a switch, electric connection from the switch to the armature of the motor, resistances in the circuit, an arm adapted to travel over the resistances and increase the amount or strength of current in the circuit to the armature of the motor, actuating mechanism for operating the arm, a device adapted to retard the movement of the arm over the resistances, mechanism for varying the retarding strength of the device, a solenoid in circuit with the circuit to the armature of said motor, and connection between the solenoid and regulating mechanism of retarding device, the connection being such that when the solenoid is excited the mechanism is thrown into action to increase the retarding strength of the device

530,798. Railway Signal. James V. Richardson, Farmville, Va. Application filed March 30, 1894.

Parallel line conductors are arranged in blocks, as specified; contact devices are carried by a locomotive to engage the conductors and a signal in circuit with the conductors; a circuit-breaker connects the blocks of line conductors, the circuit-breaker having cross-connections to connect the positive conductor of one block to the negative conductor of the next, and connections to connect the positive and negative conductors of one block to the similar conductors of the next.

530,804. Battery Switch. Heinrich K. Spangenberg, Leipsic, Germany. Application filed July 24, 1893.

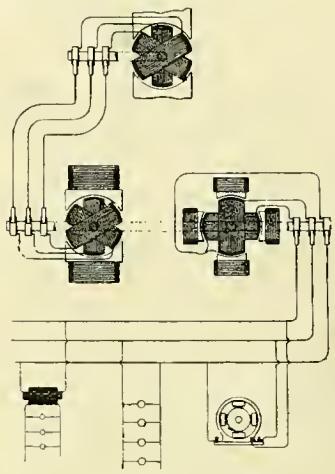
Two sets of cells are employed, and the switchboard regulates the number of cells in use. It is provided with terminals independently connected with the positive and negative poles of each set of cells, the distributing board is provided with two plates adapted to be connected with the line wires and a connecting plate or plates insulated from the first named plates, and pins connected with the terminals for engaging the plates for cutting out one set of cells or for connecting the sets of cells in series or multiple arc.

530,828. Conduit Railway Trolley. Walter E. Delabarre, Francis M. Frazer and Robert A. Carrick, New York, N. Y. Application filed January 26, 1894.

The conduit has a slot and a guard plate on one side, and the conductor is held in the conduit laterally of the guard plate, a transmitting arm is adapted to project through the slot, a trolley connected to the arm and adapted for contact w th the conductor, and an insulating covering connected to the arm and arranged essentially beneath the guard plate, the covering being provided, intermediate of the trolley and the vertical line of the guard plate, with a bevel facing in the direction of the slot.

530,838. Incandescent Lamp. Jacob R. Grove, New York, N. Y. Application filed May 26, 1893.

An incandescent lamp, with a bulb having its neck closed by an independent section of fusible material spanning the neck opening, a vertical tube of insulating material embedded in the fusible section and expanded together with leading-in wires and a filament.



NO. 530,748.

530,839. Automatic Fire Alarm. William A. Guthrie, Durham, N. C. Application filed April 26, 1894.

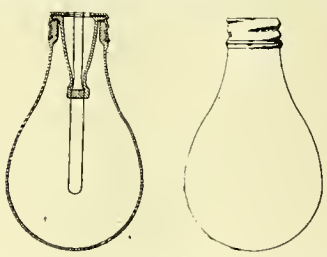
The device comprises a non-conducting base, a spring arm secured thereto, a contact plate also secured to the base, contact points on the arm and plate, a weight suspended from the free portion of the spring and normally holding i out of contact with the plate, a two-part hooked-link forming the suspension medium, an easily fused metallic alloy forming the connection between the parts of the link, and a safety back-stop arm for the spring arm.

530,867. Primary Battery. William Walker, Jr., Birmingham, and Frank R. Wilkins, Handsworth, Eng. Application filed June 4, 1894.

A primary battery having a negative element of carbon forming part of the jar containing the exciting solution, with which one surface of the carbon is in contact while the other is exposed to the atmosphere, and a saucer containing the jar and provided with a discharge, is described.

530,882. Arc Light Hanger Board. David J. Cartwright, Boston, Mass. Application filed January 26, 1894.

The combination with an arc light hanger board provided with hangers, and converging contact springs in e ectrical connection with one of said hangers, of a switch-lever in electrical connection with the other of said hangers and arranged to swing vertically with relation to the said hanger board, and the spring-



NO. 530,882.

actuated plunger co-acting with the heel of the switch-lever to complete the movement thereof in either direction, and reta n it in either of the positions which it is caused to assume, the switch-lever being provided with a heel having an apex which passes from side to side of the plunger.

530,883. Danger Signal. George M. Chace, Somerset, Mass. Application filed March 13, 1894.

In combination, a housing and vertically movable signal hidden from view within the said housing, a wheel, connections between the said signal and wheel, a weight and spring for operating on the said wheel, an audible signal operatively connected with the said wheel, a second wheel located a proper distance from the signal and connected at opposite points with corresponding points of the first mentioned wheel, two sets of levers, each composed of independent parts and having separate connection with the wheels.

530,895. Incandescent Electric Lamp. Edward Kaye, Monaca, Pa. Application filed February 4, 1893.

The accompanying cut shows an incandescent electric lamp, comprising a bulb having a neck, a tubular plug or stopple inserted in it and formed with an outwardly projecting flange, leading-in wire inserted and sealed in the plug and connected to an incandescing filament and a cap or ferrule covering the flange and connecting the bulb and plug together, the cap or ferrule being electrically connected to the filament and adapted to fit into a lamp socket and to be mechanically coupled or interlocked therewith.

# Western Electrician.

EVERY SATURDAY.

Vol XV. CHICAGO, DECEMBER 29, 1894. No. 26.


## Lighting of the Cook County Criminal Court Building.

The new Criminal Court building of Cook county, at Dearborn avenue and Michigan street, Chicago, is supplied with electric lights, of course, and the current is generated in the basement plant shown in the accompanying illustration. The building is a substantial six-story stone structure, as may be judged by the corner picture, and is devoted to the purposes indicated by its name.

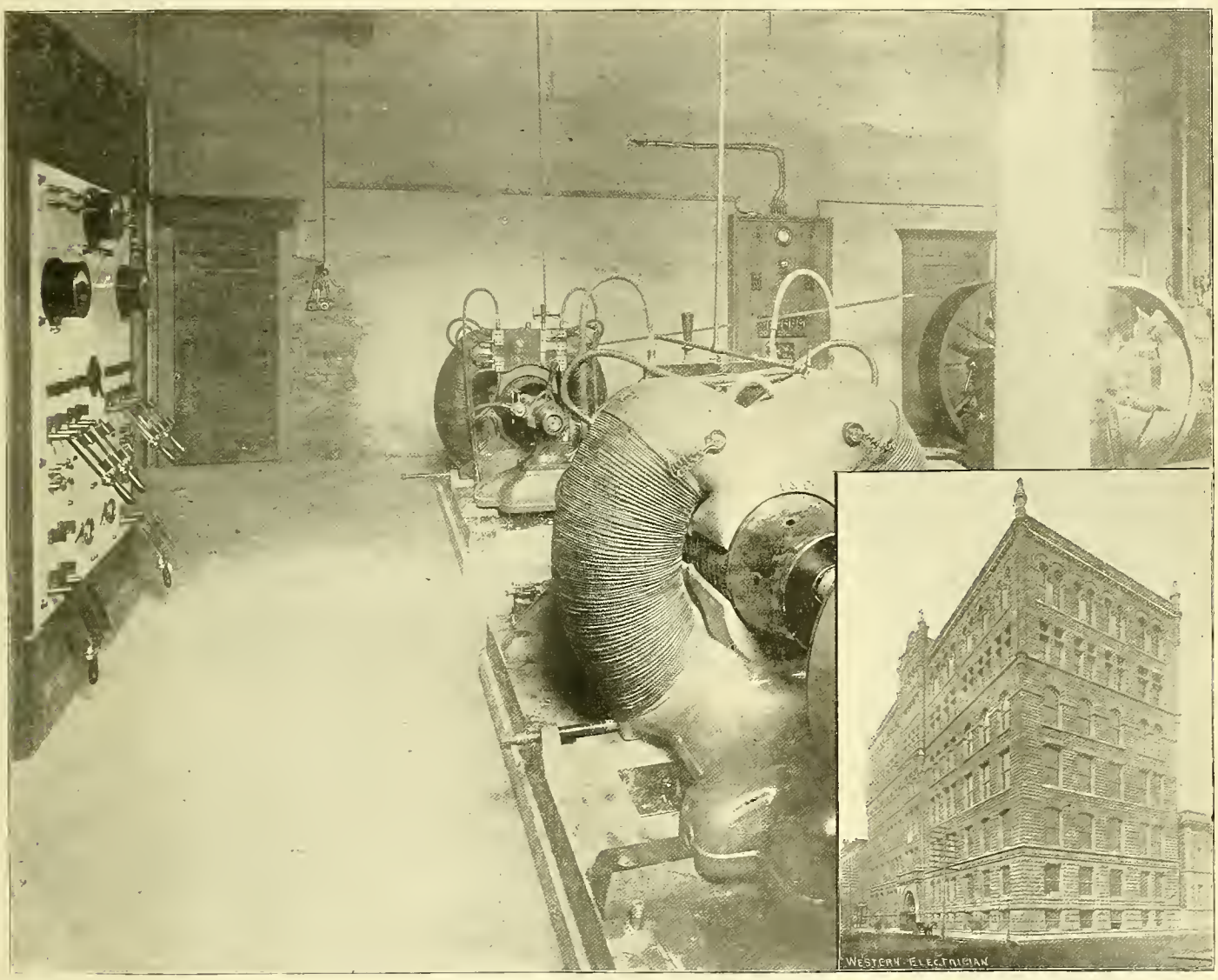
Two Ball engines furnish the power for the dynamos, the steam being obtained from a battery of five tubular boilers of 100 horse power each, equipped with Hawley down-draft furnaces. The boilers are each 16 feet long and 60 inches in diameter. The breeching leads to a brick stack 136 feet high running up the side of the building. About eight tons of soft coal is burned daily, and with this the court building and the adjacent jail are heated, while steam is furnished to Worthington pumps for five elevators—three for ordinary passenger service and two for prisoners—and for cooking and laundry purposes in the jail.

The engines in the lighting plant are each of 100 horse power, with single cylinders, and run at 300 revolutions per minute. Each is directly belted to a C & C 125 volt direct current dynamo of 50 kilowatts capacity. These machines are rated as 800 lighters and are of the usual type of the C & C company. They are operated at 750 revolutions. The leads from the dynamo to the white marble switchboard are underneath the floor. The board is equipped with Weston instruments and the usual outfit of dynamo and circuit switches, including a Cutler & Hammer voltmeter switch.

With the wiring system 1,564 lamps are connected, and the center of distribution is on the third floor. Okonite insulation is largely used.

The building is equipped with the Johnson system for automatic temperature regulation by electrical control, installed by the Chicago Electric Service company, the switchboard for which is shown on the farther wall in the illustration. An interesting feature of the building equipment is the pneumatic time plant. The master-clock is to be located in the basement, and all the other clocks in the building will be regulated from it by compressed air. This will be, it is believed, the first pneumatic clock-regulating plant in Chicago, and its operation, as compared with electrical control, will be watched with much interest.

The plant is under the direction of George W. Wade, chief engineer of the building, and R. J. Campsie, county electrician.




LIGHTING OF THE COOK COUNTY CRIMINAL COURT BUILDING.

## Susquehanna Power Transmission.

From Baltimore comes news of an extensive project to utilize the power of the Susquehanna River for electrical purposes. The report has been given definite shape by the incorporation of the Susquehanna River Electric company. George K. McGaw, John S. Bull and Winfield J. Taylor and other Baltimore and Pennsylvania capitalists are the incorporators. The Westinghouse company is said to be behind the project. The prime object of the company will be to furnish electric power to the street railways of Baltimore, Wilmington and Philadelphia and intermediate towns. The company has purchased eight miles of shore land on both sides of the river, extending from Tidewater to Conowingo, Md. At this point the stream will be turned inland and a large dam constructed. The machinery will have an ultimate capacity of 40,000 horse power. The company will be able to furnish power at less than $80 per horse power per annum. Work will be started on the dam as soon as the spring rains and freshets are over, and it is expected power will be furnished January 1, 1896. Governor Brown, president of the Traction Railway company of Baltimore, and Messrs. Elkins and Widener of the Philadelphia Traction syndicate are interested in the project.

## Down-town "L" Loop for Chicago Apparently Assured.

After much negotiating it is now stated definitely that the agreement to co-operate in using a common down-town loop terminal has been signed by representatives of all the elevated railroad companies of Chicago. After all the formalities had been complied with, Mr. Louderback issued a certificate saying that the "L" roads "had entered into a contract, which was satisfactory to themselves, for the oper-

ation of their trains over the Union Elevated Railroad company's loop, when constructed." No information regarding the route of the belt "L" was given out, but it was stated that the work of getting consents from property owners would begin at once. Electricity will probably be used as the motive power.

## Ornamental Electric Hanging Lamp.

Considerable attention has been given of late to the artistic design and ornamentation of electric hanging lamps, and many noticeable improvements have been made in this line. One of the most attractive of this class is illustrated in the accompanying cut, which shows an electric hanging lamp made for the Union Club of St. Louis by the Ludlow-Saylor Wire company of that city. This lamp is made of wrought iron with the Bower-Barff finish, which renders it absolutely rust-proof. The design of the lamp was furnished by the architect, T. C. Link, and has attracted considerable attention.

## Electrical Equipment of the Baltimore Tunnel Railroad.

In the course of a comprehensive article on the Baltimore & Ohio company's electrically operated tunnel railway in Baltimore, the *Railroad Gazette* gives this description of the electrical apparatus:

A contract was entered into with the General Electric company to furnish motors to propel the trains of the Baltimore & Ohio railroad through the Howard street tunnel. Conductors to furnish power are now being placed in the roof of the tunnel. From the masonry lining is suspended an iron trough, supported by Z-bars, containing the conducting wires. The engine will be propelled by combination trolleys, four poles being used. The locomotive consists of a double set of trucks, each having two axles and four driving wheels. On each axle is mounted a 300 horse power gearless motor supported on spiral springs resting on the frame of the truck. The motor fields are of the iron-clad type, each with separate windings imbedded in a mica-lined slot, cut into the curved body of a laminated iron armature.

The axles of the locomotive pass through the hollow shaft on which the armatures are mounted, these shafts resting on the bearings of the motor frame and being connected to the axles by universal couplings, this arrangement of parts allowing freedom of motion in all directions. Each commutator is provided with four sets of brushes, the motors being manipulated by parallel controllers in the cab. The motor can be used for pushing or pulling, and will work in either direction, it being simply a double engine. Each locomotive will have a capacity of 1,200 horse power, and will weigh nearly 100 tons; it will also be equipped with air brakes, and a whistle worked by a small auxiliary motor within the cab. It is expected that these electric locomotives, of which there will be three in use, will develop a speed of 30 miles an hour, and will propel trains over the Belt Line Railroad between Camden Station and Huntington avenue as quickly as could be done by steam.

If a freight train is to pass through the tunnel, the motor will be coupled on behind and will push the train and its locomotive through to Bolton Station, whence the two machines will run the train up grade to Huntington avenue, where the electric motor will be detached without stopping the train. With passenger trains the electric locomotive will couple on ahead, pull the train through to Bolton Station and there leave it, while passengers are getting on and off.

The power house is in process of erection at the south end of the Belt Line below Camden Station. It will occupy the hall square between Henrietta and Montgomery streets, with the side of the building on Howard street. The power house is a one-story structure, substantially built of red brick. It will be 30 feet high to the eaves, 338 feet long on Howard street, and 69 feet wide. The boiler room is separated from the machinery apartment by a heavy brick firewall. It is 69 by 98 feet and space is provided for a battery of 12 Abendroth and Root boilers, of 3,000 horse power. In the engine room will be set up four Allis-Corliss compound engines of 750 horse power each.

The machinery room is 58 by 240 feet in dimensions. The Corliss engines have direct connection with four generators made by the General Electric company, capable of delivering 2,700 horse power. In addition there will be in the boiler room four Armington-Sims engines, each 250 horse power. Two of these will run eight arc machines, each with a capacity of 50 arc lights, and the other two engines will run two alternating dynamos, each with a capacity of 2,000 lights. By means of this enormous light equipment the Howard street tunnel will be made as light as day. The several stations, arches and cuts of the Belt Line will be illuminated at night, ample room being left in the power house for additional machinery.

The excavations and embankments of the Belt Line Railroad are all completed, a small part of the masonry on the retaining walls of the Bolton lot cut remaining unfinished. Tracks are laid over the entire course, but not yet ballasted. The electrical engineers are at work in the tunnel, and workmen are crowding up the walls of the power house as rapidly as possible. Finishing touches are being put upon the bridges and masonry and the greater part of the work will be completed by January 1st. Trains can be run over the line soon afterward, while the depots are building and final repairs to the cuts and embankments are being attended to.

The electric plant and the rolling stock and franchise of the Capital City Railway & Lighting company of Baton Rouge, La., have been advertised for sale in execution of judgment obtained by the Bank of Baton Rouge, the holder of about $40,000 of mortgage notes.

## On the Production of Rotary Magnetic Fields by a Single Alternating Current.[1]

By Ludwig Gutmann.

Since the first announcements of Prof. Ferraris and Mr. Tesla, that rotation can be accomplished by employing two or more alternating currents of displaced phase, the question has been raised by many an engineer as to the possibility of producing a rotary magnetic field by the use of a single circuit, carrying the ordinary alternating current, instead of requiring three or more wires or several independent circuits. So far it has been necessary to construct a special generator armature, the windings of which were rotated in a field of constant polarity, to produce two or more currents lagging in phase behind each other. To use the currents generated for establishing a progressive or rotary field, it was necessary to carry as many wires to the place of consumption as currents were employed differing in phase. Six years have passed, and quite rapid progress has been made in various directions. I wish now to bring to your notice a method of generating a rotary magnetic field by a single alternating current or its field, without condensers or choking coils. This is accomplished by a device brought out by me some three years ago. Its fundamental principle is hardly as yet appreciated; however, the World's Fair exhibits as well as literature of late show that the device has attracted attention, and that several engineers have approached the principle involved.

I wish to refer to my motor and especially to its armature described in 1891.[2] Figs. 1 and 2 show the device. The former is principally used in the American patents, while the latter is given in the English patent of the same year. The

ORNAMENTAL ELECTRIC HANGING LAMP.

novelty of the armature construction lies in a winding containing closed sub-circuits; and another point is that the closed circuits do not coincide in number with the poles of the field magnet. Before going into the action of this device, I will mention two simple experiments which are essential in order to understand the operation of this rotary magnetic field system.

If we have a closed coil moving in an alternating magnetic field, or better, between the poles of a field magnet as illustrated in Figs. 3 and 3*a*, energized by alternating currents, then the coil *A* will be repelled from the pole, owing to the secondary field which it establishes, so long as it cuts, or is threaded by the lines of force of the field. The consequence is that it will rotate, and place itself between the north and south pole, Fig. 4, where it reaches a stable magnetic equilibrium, as I like to term it, because in this position it acts like a pendulum properly suspended, Fig. 5. Any motion imparted causes the pendulum to make a few oscillations and come to rest, and similarly any attempt made to move the coil into an energized field will cause it to be repelled, and after a few oscillations it will remain at rest between the poles. It is repelled in either direction, because as soon as it approaches a strong magnetic flux, currents are induced in its windings and create an opposing field. The same coil can be in unstable magnetic equilibrium, Fig. 6, if it stands just in front of a pole, in which position it would act like a pendulum which is balanced with the weight above the point of support, Fig. 7. Both are in unstable equilibrium; the least motion to the left or right imparted to either will cause them to accelerate in the direction of the impulse, and to assume a position of stability, Figs. 4 and 5. In this position, Fig. 4, the coil is therefore currentless. This stable position is the natural position of synchronous motors in operation.

If such a synchronous motor is held behind the phase when rotating under load, a heavier current is induced in the spools which accelerate the armature and keep it in step. If, however, the motor runs in harmony, and suddenly a great deal of the load is taken off, then the armature has a tendency to go more quickly, but in this case opposing currents are generated in the windings which retard the speed of the armature and keep it back, to remain in step, or in stability.

Let us look into the device before us, and consider first its quality as a motor. Returning to Figs. 1 or 2, preferably the latter, which is simpler and easier to explain, we find that if we send into the field magnet coil an alternating current, the armature will turn through a certain angle and stop. This motion depends upon the position of the three closed coils with respect to the two poles. This same device can itself be self-starting if we make the poles far enough apart and the energizing current sufficiently strong, so that at the initial speed the armature is repelled at a certain rate. This initial speed changes with the number of poles, closed circuits and alternations. Let us take the first case and examine it. If we try to rotate the armature (as I shall call it hereafter) in a field of alternating polarity, we induce currents in the closed circuits, which establish poles, but these poles are alternating in nature, and owing to the motion imparted, and owing further to the permanent connections in the winding, the poles move or travel with the latter. This accounts for the fact that if the field poles are close together the armature consumes power during its rotation through the alternating field; it acts as a dynamo and does not start from a state of rest. If we impart by mechanical means an impulse to the armature, currents are generated whose sum has a variable and principally negative value. The armature makes a few revolutions and places itself in a stable magnetic equilibrium, viz., in such a position, symmetrical if possible, as not to generate any currents, and hence not to induce any reactionary[1] poles in the core. If, however, we impart to this armature a certain initial speed, which I shall call the critical speed, then it will continue to rotate, with a tendency to reach a certain fixed higher speed. This initial impulse may be given by mechanical or electrical means. I shall not state the results as yet, but prefer to explore the action first, so that the same may be before us in various diagrams, and enable us to make any deduction desirable. First, let us assume that the armature rotates synchronously. It is evident that in order to have an armature with three close-circuited coils, interconnected as shown, rotate in one direction, we must have currents induced whose sum has a positive value, viz., two of the coils must do work, in the same sense, while the third coil is either without a current, or has a smaller current in opposite direction, so that the value still remains positive. For true synchronism a close-circuited coil reaches within a half period the opposite pole, and consequently our diagram for one revolution would appear as shown in Fig. 8.

The three diagrams, *a*, *b*, *c*, show the flow of currents and resultant poles. The close-circuited coil *2*, diagram *a*, is at this moment generating opposing currents to the others; coil *1* is passing just in front of a pole. All three induced currents combined are developing poles as indicated, and rotating the armature in counter clockwise direction. The rotation being synchronous, diagram *b* shows the position of the armature when the polarity in the field has reversed; diagram *c* gives the position of the coils after the polarity has changed again. It will be noticed that the original position, as shown at *a*, has been reached again, and that the cycle will repeat itself. Without explaining these diagrams at this point, I wish to bring before you several other conditions, all of which will assist in reaching definite conclusions. Looking at the armature we see that it has a symmetrical winding, and as long as these closed circuits do not coincide with the number of poles of the field magnet (contrary to all synchronous motors built heretofore), other working positions are

1. Read before the American Institute of Electrical Engineers, December 19, 1894.

2. *Electrical Engineer*, vol. xii., August 26, 1891, p. 230.

1. It is well to call the armature poles due to the armature currents reactionary poles. The other armature poles are induced directly by the field poles, and contribute nothing to the torque.

possible. The operation will take place as long as the sum of the armature currents has a positive value, since as far as the rotation is concerned it is indifferent which of the coils are doing the work. Let us assume that the armature does not run at a synchronous rate, but at another fixed speed which may have a certain commensurable relation to the periods of the exciting field current, which speed I shall call the harmonic speed. Instead of showing the diagram with windings as in the first set, I have simplified them. In the following sets of diagrams, Fig. 9, I assume that the armature, on account of the load or other reasons, cannot reach synchronism, and that at each field reversal the position of the armature with respect to the field is the same, only the coils have changed places as indicated. You will notice that in this set of diagrams the armature, for each half-period, makes one-third of a revolution only, namely coils *1*, *3* and *2* exchange positions with the change of polarity. Let us step at once to another speed, Fig. 10, which you will no doubt admit as possible, viz.: Let us assume that coils *1*, *2* and *3* cannot arrive at synchronous speed, and that coil *2* reaches the position which *1* ought to occupy, it will be seen that owing to the symmetrical position, it is quite indifferent which of these coils arrives at a given position required for

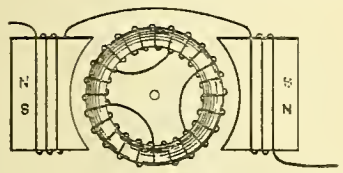



FIG. 1. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

harmonic operation. This will be clear to you by referring to the third set of diagrams, Fig. 10.

We are now enabled to compare three sets of diagrams, Figs. 8, 9 and 10. The first set shown for this new type of synchronous motor that at synchronous speed the pole positions in the armature are practically stationary relatively to the coils and core, and rotate with it. The second set shows that during a complete revolution of the armature, the field has reversed three times, that is, an odd number of times, hence, when the armature returns to its original position, after a complete revolution, it finds the field magnetization of reversed polarity. The magnetic field of the armature rotates in the opposite sense, one and a half times per revolution. In the third set, the armature makes but one-sixth of a revolution per half-period, and the magnetic field of the armature in a complete revolution rotates three times in the opposite direction. This statement may be startling, and my argument, so far, may not be entirely convincing, as on close inspection it will be found that the armature poles have to do considerable jumping. I will now explain the performance of the rotary magnetic field of this armature in a four-pole field, where the changes occur far more gradually, leaving no doubt whatever as to the assertion made. Fig. 11 shows diagrams illustrating synchronous speed. By the aid of these four diagrams we can more easily follow the pole positions in the armature core, and find them stationary in it. Inspecting now Fig. 12, in which the armature speed is reduced, we are able to obtain a clear picture of the main subject under consideration.

In this set of five diagrams we see five positions, which coil *1*, for instance, occupies before it has made one-third of a revolution. Nevertheless, if we now look at the changing pole positions we can readily detect that they are progressively shifting and we also see that they have made one whole revolution and that in opposite direction to the mechanical rotation, or, in other words, the magnetic field would travel three times around the armature core during one revolution. In all armature diagrams described and to be described, the resultant of the magnetomotive forces of the armature currents is given only. To complete the picture showing every one of the component magnetomotive-forces acting, it becomes desirable to plot a diagram of force, Fig. 13. These components act like three variable concurrent forces including an angle of 120 degrees with each other. These forces we may represent as equal, for the sake of convenience, as it does not influence the idea which we wish to

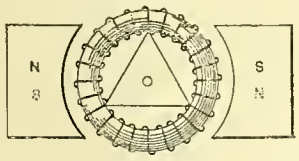



FIG. 2. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

illustrate. However, those two forces which are acting in the same direction are indicated by heavier lines.

Plotting the direction of the forces in order, as, for instance, in the last named set of diagrams, Fig. 12, where the coils act in the order *1*, *2*, against *3*; *3*, *1*, against *2*, and *2*, *3*, against *1*, we obtain Fig. 13 for one cycle. The three figures marked *a*, *b* and *c* indicate the direction in which the three forces are acting in the three positions of one cycle or revolution.

By drawing the resultant diagram of force from the predominating forces of each position, we obtain the accompanying illustration, Fig. 14. These forces form a triangle and the rotation resulting may be seen from the direction of arrows on the circumference of the surrounding circle. However, the reactive forces should be considered and represented separately to obtain the true picture and we have to add them to find the total force applied and the manner in which all the forces are acting. We therefore repeat the resultant diagram, Fig. 14, and add the opposing forces at their proper places. This diagram, Fig. 15, shows that the reactive forces, shown by dotted arrows, also have a common center, and that, as regards time of maximum effect, they succeed each other in the direction of rotation of the armature, while they are acting in the opposite direction of the main force. If we now plot a diagram of these reactive forces alone, we obtain the smaller triangle shown, Fig. 15, inside the larger. It will be noticed that rotation is in the opposite direction; or, in other words, that in reality we have, with this disposition, to deal with two rotary magnetic fields in opposite direction; the useful work done will depend on the difference of the angular velocity of these two rotating fields and their relative intensity.

Looking now at the device as a generator, Fig. 12, we can account for the rotary magnetic field because we generate polyphased currents in the coils *1*, *2* and *3*. They operate together in the following order: *1*, *2*; *3*, *1*; *2*, *3*; *1*, *2*, etc. If rotated, as shown, the coils will distribute three-phased currents over the armature, and this will be understood when examining into the flow of currents of the close-circuiting conductors which are here provided with arrows. At this particular harmonic speed, it will be further noticed that the simple alternating field of force has the identical qualities as a polyphase energizing field, as the poles in front of the close-circuited coil seem to be traveling (for the armature) in clockwise direction. This is indicated by the shading of the pole of same sign in front of the coil most powerfully acted upon in the five positions, representing one revolution for the field. The currents displaced in phase cause the armature to rotate harmoniously with the alternations, and prevent the armature from being easily thrown out of step.

Returning once more to the earlier diagrams, Figs. 9 and 10, we see that below synchronism there are two other speeds which are entitled to be called synchronous, because a certain fixed relation exists between the periods of field excitation and armature rotation.

It will be evident that the greater the number of closed circuits, the greater is the number of harmonic or synchronous speeds in which the armature can operate. If the armature contains ten closed circuits, and rotates in a two-pole field, it will be able to generate five currents, lagging 72 degrees behind one another in phase, and would have at least five speeds which are synchronous, and the armature, owing to its peculiar construction, can operate at a slower speed than the synchronous speed as interpreted heretofore.

Looking at the device from a general standpoint, it will be clear that this particular armature construction embodies all

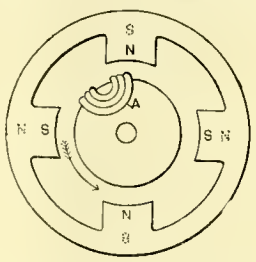



FIG. 3. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

the weak points of a synchronous, and all the strong points of the polyphase motor. The weak points are:

1. That the machine will not start from state of rest in the form shown, because in Figs. 1, 2 and 12 the coils act on one another differentially and have a variable and negative value; they are in magnetic stability when at rest, hence no rotation can result.

2. The device has a small starting torque when rotated, owing to the differential action of the coils, which cause, with a small number of closed circuits, strongly oscillating or jumping poles, until a harmonic speed is reached.

3. The device, when in rotation, is not reversible by simply changing circuit connections.

The strong points are:

1. That the motor develops polyphased currents in its own windings.

2. That therefore it is more difficult to pull it out of step, as it has the capacity to stand, what I would term, magnetic slippage.

Let us assume that a certain coil, which should reach a given point to run harmonically, remains behind, owing to a slower motion of the armature; in this event the coil ahead has to perform the function at the expense of a heavier current. The loss of revolutions due to this action may be comparable to the slipping of a belt over a pulley. However, there is also a limit to the slipping. The armature should have some harmonic speed with respect to the alternations. Should it fall below the lowest harmonic speed, then it will come to a standstill just like any other overworked synchronous machine.

Synchronism in a motor means nothing more or less than a magnetic flexible clutch, which may be represented mechanically as follows:

The old-fashioned non-starting synchronous machine having equal armature coils and field poles can be compared with the arrangement shown in Fig. 15*a*, giving side view and elevation. The disk *1* is provided with two projections; *2* imparts rotation to shaft *4* by means of the flexible arm, or spring *3*, which enables the shaft *4* to be slightly behind or ahead of disk *1*. However, if the work put on shaft *4* is in excess of the strength of spring *3*, then it will break, and shaft *4* will speedily come to a standstill.

In contrast to this older form of synchronous motors stands the new one, which forms the subject of this paper and the machines operated by bi- or polyphased currents. The mechanism for showing magnetic coupling for these latter types may be represented by Fig 15*b*. In this case, *1* represents a crown wheel, the teeth marked *2*; into these teeth meshes a catch *3* in a flexible manner, which catch is connected rigidly to shaft *4*. Within the range of normal work, catch *3* would remain fixed between the two given teeth, but if the shaft *4* is overloaded, the flexibility of catch *3* will cause it to yield, and pull out of its position, drop in between some other two teeth, and continue to operate, but at a slower speed. The greater the excess of work, the greater will be the slippage, and the more teeth will be jumped by the catch *3* in every revolution of disk *1*. For the synchronous motor herein described, the overloading to the extent that it cannot reach the lowest harmonic speed would be equivalent to the breaking of spring *3'*.

It will be remembered that Prof. Ferraris obtained a rotary magnetic field and rotation by influencing one coil carrying a primary current by another at right angles thereto carrying secondary currents. Here we have two phases from a single source, Fig. 16. To obtain a multiple of phases we may take two or three iron cores *A*, and surround them with coils *B*, like the links of a chain, Fig. 17, so that the secondary coil of transformer *1* is the primary of transformer *2*, and so on; or we may design a special core for a transformer, and create a rotary magnetic field by applying to one coil a primary current from the line, and to another coil a secondary current from a transformer, whereupon, by the rotary field obtained, polyphased currents may be taken through other coils on the transformer. These methods have, however, one drawback, and that is that the phase will change more or less in lag with difference in load, while for many purposes it is

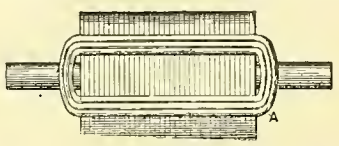


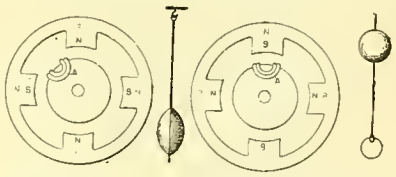

FIG. 3*a*. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

most essential that for efficient working the phase should remain at the same constant angle. This desideratum has been accomplished by the device under consideration, and any suitable number of currents lagging in phase may be obtained from a single alternating current.

To obtain a rotary magnetic field in or by a stationary body, at least two electric or electromagnetic forces of definite phase relations, acting at an angle to one another and changing at periods harmoniously, are essential requirements.

If, however, we allow the body, or part of the same, to be movable, we may substitute mechanical rotation primarily as an adjuster of the periodicity and phase of one of the two forces; the fundamental relation between the two forces must in this case also be the same as in the other; namely, they must work in harmony and the periodicity and phase determines the periodicity and phase of the other of one force. If the second force is a current, it must be one of the same period or some harmonic of that period; if it is rotation, it has also to be synchronous or harmonic. We can now clearly understand why, when rotating the armature, Figs. 1 and 2, in an ordinary alternating current field we have no system of polyphased currents and no rotary field, simply because the armature rotation does not stand in any relationship whatever to the alternations; but as soon as the speed does so, there are generated polyphased currents lagging in phase at a fixed angle and a rotary magnetic field.

There is a difference whether the armature is influenced by a single alternating current, or by several, causing themselves a rotating energizing field. Nevertheless, in either condition the armature is in magnetic stability, and this state is the reason that it remains stationary in the first case, and that it rotates in the second. The reason that the motor starts in the second case is evidently because the inducing magnetic field is itself rotating in the stationary field magnet core. As said before, it is considered necessary for the proper operation of the armature for giving maximum torque, that if placed in an alternating current field of force, the armature rotation should have a definite relation to the alternations. Up to the publication of this device some three years ago, synchronous motors had as many armature coils as field coils, and hence to obtain the value of the synchronous speed, all that was necessary was to divide the alternations of the armature current *n* by the number of field poles *p* of the magnet employed. But if the number of armature coils is not the same as the field poles, then the speed may vary from this synchronous speed and a modification is thought to be necessary. We would have to find the smallest common factor between field poles *p* and armature coils $p^1$ with which we have to divide the number of alternations to obtain the value of the lowest synchronous speed while the condition of slippage may allow for the lowest harmonic the value $\frac{n}{p\,p^1}$.



FIGS. 4, 5, 6 AND 7. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

It will now be clear that motors can be designed having any desired variation of speed and have defined synchronous speeds or approach the indifferent relation. I wish it understood that I do not intend to treat the subject in all its details, and I am especially reluctant on the ground of having carried on but few experiments.

The few diagrams presented do not disclose many conditions of those possible. They show only one or two facts of conditions which frequently are of a complex nature. Evidently, the rotary magnetic fields in the device under consideration may have altogether different speeds from those shown in the diagrams; also, that the magnetic field may rotate with and ahead of the armature, and, lastly, the speed

of rotation of the rotary field of the armature may be synchronous and opposite in direction to its rotation.

The device has been given in form of a diagram, and as it has been described as not self-starting I wish now to state that it becomes self-starting as a series, a shunt or an induction motor in a field of single phase or polyphased alternating currents. Fig. 18 represents one of the earliest forms which have since been simplified to a considerable extent. The part *A B* represent here a simple series motor whose armature *B* may be any drum or ring type open or closed coil winding; the part *C D* may be similarly constructed. Both armature windings *B* and *D* are connected electrically by four wires *E* at points of equal distance, which number of conductors *E* may be reduced or increased, depending on the number of phase currents desired. Now send an alternating current into the series motor, part *A B*[1], then the armature will start from state of rest and will send current impulses into the *D* part winding, which becomes the more regular the more the armature has approached synchronous speed, where bi-phase currents will be established therein; these react on the field magnet core *C*, and for the purpose of maintaining the armature in this synchronous speed the commutator *F* is applied to rectify

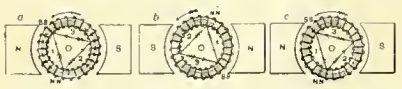


FIG. 8. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

the polyphase currents, which continuous current may be used to energize the magnet *C*.

The fundamental principle disclosed opens to us a very wide field for work. Not only are we enabled to construct motors almost as cheap and simple as continuous current motors, but there is in this principle involved the germ for the ideal distribution of power, inasmuch as we are enabled to collect the polyphased currents generated or commutate them immediately at will.

Finally, I wish to call your attention to the fact that the last figure is in reality a motor-generator, and it is therefore evident that the electrical energy supplied need not all to be transformed into mechanical power, but that a portion may be utilized in one of the modified forms named above.

## Berliner Patent Decison.

Following is the full text of Judge Carpenter's opinion in the Berliner case, announced in the last issue of this journal:

This is a bill in equity praying the repeal of Letters Patent No. 463,569, issued November 17, 1891, to Emile Berliner as assignor to the American Bell Telephone company for combined telegraph and telephone. The first ground of the bill to which I shall refer is that the patent is void as being beyond the power of the commissioner to issue, in view of the issue of a former patent, No. 233,969, issued November 2, 1880, to Emile Berliner for electric telephone.

The patent of 1891 is for a transmitter for a speaking telephone. The fourth claim of the patent of 1880 is as follows:

4. A system of two or more telephone instruments in electrical connection with each other, each consisting of two or more poles of an electrical circuit in contact one with the other, either or both poles of each instrument being connected with a vibratory plate so that any vibration which is made at one contact is reproduced at the other, substantially as set forth.

This patent is, therefore, for the "system" or combination of a transmitter and a receiver for a speaking telephone. The whole apparatus is shown in the drawings of both patents and is identically the same in both. The transmitter and the receiver are identical in form and differ in function according as they are placed at the transmitting or at the receiving end of the telephone wire. It, therefore, appears that one of the functions of the device shown in the patent of 1880, namely, the function of transmitting articulate speech, is identical with the sole object or function of the device covered by the patent of 1891 and that the device for effecting the transmission is identical in both patents. The patent, therefore, seems to me to be void and beyond

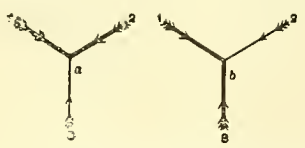


FIG. 13. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

the power of the commissioner to issue. (Miller v. Eagle Manufacturing company, 151 U. S., 186.)

The second ground of the bill is that the issue of the patent was unlawfully delayed through the fault of the respondents. The respondent company were the owners of a patent previously granted to Alexander Graham Bell, which covered the art of electrical transmission of articulate speech. The device of Berliner, as both parties in this case agree, covers the only commercially practicable and useful method at present known for effecting such transmission. In this state of facts, the claim of the complainant under this bill is fully and briefly stated by counsel in the following words:

"The proposition is that the Bell company intentionally delayed the prosecution of the Berliner application and the issue of the Berliner patent for the purpose and with the result of prolonging their control of the art of telephony, which would cease with the expiration of the Bell patent in 1893, and that they did this by submitting to delays on the part of the officers of the Patent Office, which delays they, the Bell company, had it in their power to prevent, and refrained from preventing, for an unlawful purpose. This conduct is alleged to constitute a fraud practiced upon the public through the commissioner of patents and his assistants. And it is claimed that the patent so obtained by such fraud may be and should be annulled by the decree of the court, on the authority of the United States v. American Bell Telephone company, 128 U. S., 315, because there is no substantial difference between fraud practiced upon the commissioner as an agent of the public, and a fraud practiced upon the public with the commissioner's connivance or acquiescence."

The application for the patent was filed June 4, 1877, and the patent was issued November 17, 1891. The patent to Bell expired in March, 1893. The device covered by the patent in suit had been in public use by the respondent corporation since the year 1878. The respondent corporation was of ample means to prosecute the application. The result of any delay which might take place in the issue of the Berliner patent would evidently be to continue so much longer the practical monopoly of the art of electrical transmission of articulate speech. Under these circumstances, I think it clear that the duty of the respondent corporation was to use the greatest degree of diligence in prosecuting the application to an early issue. There should have been, at least, as great diligence as their own interests would have called for, had their business been unprotected by patent rights.

Thus far there is no dispute between the parties here. It is admitted that the greatest diligence was incumbent on the respondent corporation, and that if there be unlawful delay and if there be bad faith and an intention to delay on the part of the applicant, then the patent may be here held to be void.

From the filing of the application up to June 9, 1882, it is not contended that there was any delay upon which a decree here should be founded. There were delays in prosecuting the application, but they are said to be no greater than is usual in the Patent Office. On the date last given the solicitor in charge of the application was notified by the examiner that "as at present advised, it is believed that the claims presented may be allowed, but final action in this case must be suspended in view of probable interferences with other pending applications."

In October, 1883, the solicitor wrote to the office asking that the case might receive attention, to which it was replied that the apprehended interferences had not yet been declared, and the correspondence was continued in the same sense until March, 1888, when the application was suspended until May 1, 1888, on the ground of the expected interferences, and also "for the purpose of awaiting the

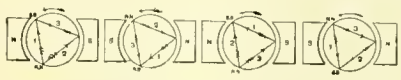


FIG. 9. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

determination of the telephone cases in the Supreme Court."

The application with which an interference was anticipated was that filed July 26, 1880, by Daniel Drawbaugh, in which he claimed to be the original and first inventor of the telephone. His claims were rejected on the ground that the instrument which he claimed to have invented had been in public use and on sale for more than two years before the filing of his application. He had filed an affidavit in which he denied that there had been such public use with his consent and allowance. There was abundant evidence on file in the Patent Office by which was shown the fact of public use as early as July 26, 1878. It had been declared in Manning v. Cape Ann Isinglass & Glue company, 108 U. S., 462, that the statute then in force did "not allow the issue when the invention had been in public use for more than two years prior to the application, either with or without the consent or allowance of the inventor." The case was then pending of the Bell company against the People's Telephone company, owners of the alleged telephone inventions of Drawbaugh, in which was involved the question whether Drawbaugh had in fact invented the telephone at the early day claimed by him, or whether on the other hand his claim was entirely false. Under these circumstances there was set on foot a "general understanding" as it is called, on the part of the examiner and the respective counsel for Drawbaugh and for the Bell company, that the decision of the application for the Berliner patent should await the decision of the pending suit. There seems, on the testimony, no doubt that the Bell company fully acquiesced in this general understanding; and I think that in so doing they failed in their duty and committed a wrong against the public.

It was evident that in no case could Drawbaugh be entitled to a patent. He was clearly barred by the prior use of his invention. On the other hand it is to be observed that the action against the People's Telephone company might not be finally decided for many years and that when decided it would not necessarily throw any light on the question then pending in the Patent Office; namely, whether Berliner or Drawbaugh was the first inventor of the microphone transmitter. The suit was for infringement of two of the early patents issued to Bell, the first for the electrical transmission of sound, and the second for a receiver. The answer denied the validity of the patents, alleged anticipations and further averred generally that Drawbaugh was the first inventor of the speaking telephone. The invention of the microphone, a particular form of the speaking telephone, was therefore not in issue. The case made by the People's Telephone company, indeed, as was well known, was that Drawbaugh had invented the whole telephone system, as it was then known, including the microphone, long before Bell's invention. If this were found to be the fact, then, of course, it would follow that he had anticipated Berliner as well as Bell. But, if this were found not to be the fact, that finding would throw no light on the question whether Drawbaugh had or had not invented the microphone subsequent to Bell and prior to Berliner. It could never appear in the Patent Office, therefore, that Drawbaugh was entitled to a patent; and only in one aspect of the telephone case could it be decided that Berliner was not entitled to a patent. The plain duty of the respondent corporation, as it seems to me, was to press these considerations in the Patent Office and insist on its right to a patent at once, leaving the question which was pending in the courts to be settled whenever a final decision should be reached and leaving the decision of that case to have whatsoever effect it lawfully might on the validity of the patent. The commissioner on such an application might properly have been asked to take proofs, on notice to Drawbaugh, so as to ascertain *prima facie*, and with sufficient certainty for the purpose of an administrative decision, by whom the first invention of the microphone had been made. It would well have been urged on him that it was his duty to make such an investigation of a question which was not in issue in the pending suit and

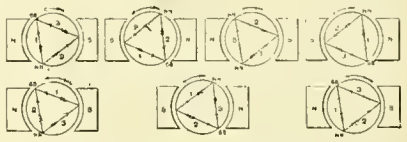


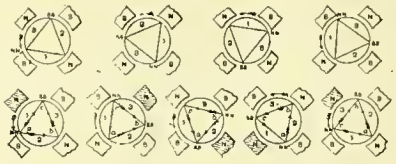
FIG. 10. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

which the decision of that suit might furnish no guide in determining.

It is objected that there was no established practice in the Patent Office by which the question of priority of invention could be ascertained, and that for other reasons such an application to the commissioner had no prospect of success. It seems clear to me that the duty of the respondent corporation was to test these questions rather than to consent that they must be decided against them—for an acquiescence in the delay seems to me to be no less than a consent that no favorable result would come from the application.

That the unwarrantable delay thus caused was intended by the respondent corporation I can have no doubt. In matters of this consequence, involving the whole business of a company of so large capital and engaged in so large affairs, I cannot doubt that they were fully advised both as to the facts and as to the law; and I think "that their acts were so gross as to forbid any inference except that they dishonestly delayed" the issue of the patent, taking advantage for that purpose of the perhaps excusable willingness of the officials of the Patent Office to postpone the decision of a sharply debated question, in which a large public interest was involved, on the chance that a decision of the Supreme Court might supersede the necessity for a decision on their part.

In March, 1888, a final decision was rendered by the Supreme Court in the action against the People's Telephone company, and the claim of Drawbaugh to the invention of the telephone was held to be unfounded. In June, 1886, the examiners in chief of the Patent Office had decided that Drawbaugh's application was barred by reason of two years' public use of the invention, and the time for an appeal from this decision expired in June, 1888. The commissioner then set on foot a proceeding to determine whether in fact there had been a public use of Drawbaugh's invention for two years before the date of his application, and the Berliner application was still suspended to await the result of an interference which might be declared in case Drawbaugh should prevail in the public use proceeding—the rule of the Patent Office being that no interference could be declared unless in cases where the interfering applicant, if successful in the interference proceeding, would be entitled to a patent. This public use proceeding, whose purpose is to permit the applicant to be heard on the question of public use when that question has been raised by the office, was strenuously objected to by Drawbaugh, who took no evidence in the proceedings. In October, 1891, the proceeding came to an end by a final decision of the com-



FIGS. 11 AND 12. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

missioner to the effect that Drawbaugh was barred by the prior use of his invention. On the next day the Berliner patent was ordered to issue "largely because well settled principles of public policy forbid us to give any further opportunities for holding this application in the office."

There was no effort, so far as I can see in the evidence, on the part of the respondent corporation to prevent this further delay. There was ample evidence before the commissioner of the fact of prior use; the applicant, Drawbaugh, declined to take evidence in contradiction; and it seems to me clear that the respondent corporation should have urged upon the Patent Office a decision on the *prima facie* case which they had made.

I am persuaded that the delay thus caused, as well as the delay previous to the decision of the Supreme Court, was intentionally acquiesced in by the respondent corporation for the purpose of delaying the issue of the patent. This seems to me the only conclusion from a consideration of the whole evidence. It is in proof that during the whole of the time, from 1882 to the issue of the patent, and perhaps earlier

[1] preferably so that no reaction takes place from part *D*.

the solicitors of the Bell company were urgently insisting to the officials of the Patent Office that prompt action should be taken in the application. Even while the "general understanding" was in force to the effect that the application should await the decision of the Drawbaugh case in the courts, the evidence shows that these urgent applications were made to the Patent Office officials. I cannot think that it was by anyone expected that such oral applications should have any effect, unless, at least, they were made in support of formal applications made on the record and of formal arguments and representations made in support of such applications. The officers of the company also testify that at all times they were urgent in pressing for the issue of the patent. As to their state of mind and their actual intention at the time, I am free to say that I place less reliance on their statements now made than on a single statement made at the time. In February, 1886, while the "general understanding" was in force, Mr. Swan, one of the solicitors for the application,

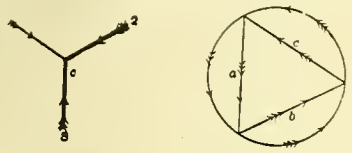


FIG. 14. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

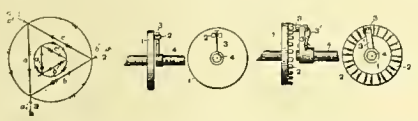
wrote as follows to the president of the Bell company: "I am working the Edison and Berliner cases along quietly and think they will be granted by the examiner without interferences or appeals, so that we can take them out by paying the final fees. We have six months to do that in." This is but a single paragraph out of many hundreds of pages; but I think it shows clearly what was the purpose of the respondent corporation, consciously formed by their officers and perfectly understood by their agents at the Patent Office. The application was to be "worked along quietly," although apparently pushed with great energy; there would be delay, but no substantial obstacle to the grant of the patent; and even after the patent should be ordered to issue there might be a further delay within the limits of the law and without imperiling the patent. If this letter does not mean this, I am at a loss to know what it does mean.

My conclusion, therefore, is that the complainant has made out the case and that there should be a decree that the patent in question is void and shall be delivered up to be cancelled.

The decision annulling the Berliner patent excited the greatest interest in all parts of the country. Lawyer Frederick P. Fish, the eminent counsel for the Bell Telephone company, speaking of the decision rendered by Judge Carpenter, said: "The case will now go the United States Court of Appeals, and a decision will possibly be rendered next spring, after the case has been argued anew, as though the Circuit Court had not made this decision. If the case is decided against us it will be taken to the United States Supreme Court."

The case was argued from June 14th to the 20th. The government's special counsel were Causten K. Brown of Boston and Robert S. Taylor of Fort Wayne, Ind. The telephone company's counsel were Chauncey Smith, J. J. Storrow, F. P. Fish and C. H. Swan. The costs in the case are enormous, the record alone making two large printed volumes, costing over $3,000. By the court's decree the costs are to fall on the telephone company.

On the New York Stock Exchange the effect of the decision of Judge Carpenter was to send down Bell Telephone stock with a rush, and for a few minutes there was great excitement around the Bell pole. The stock had opened unchanged at 200½, and when the news of the decision reached the street it slumped by degrees to 191. From



FIGS. 15, 15*a*, 15*b*. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

this point it recovered to 194, and at one o'clock was selling at 192.

Secretary Patrick S. Egan of the Harrison company said: "The decision rendered by Judge Carpenter against the Bell Telephone company declaring its Berliner patents void practically ends this great monopoly. The Bell Telephone company has lorded it over the public for a number of years, and, not satisfied with the allotted time allowed by the United States Patent Office, it endeavored to extend its patents for another seventeen years. But the United States government would not permit any such proceeding, and this decision gives the Bell Telephone company its just deserts."

President Stone, of the Central Union Telephone company, Chicago, was questioned concerning the telephone decision and replied: "I know no more about the finding of the court than appears in the newspaper dispatches. Whether it will affect the Bell company, from which concern we rent our instruments, is a question I cannot answer. The Berliner patent, which provides for a battery in connection with the transmitter, is in use on the Bell instruments, and this decision appears to be against Bell as well as against Berliner."

In view of the present encouraging telephone situation it is of interest and importance to reproduce a circular issued by the Bell company itself on December 20, 1878. It will be observed that the company at that time spoke very of the comparative merits of battery-transmitter and magneto telephones:

We take pleasure in announcing to our agents, customers and to the public that we are now ready to furnish a battery-transmitting telephone in addition to and to use in connection with our ordinary magneto telephone.

In the magneto telephone the sound waves are thrown against and vibrate a diaphragm which acts as the armature of a permanent magnet, and, disturbing its magnetic field, produces in the helix or coil surrounding the magnet undulatory currents of electricity, which are conveyed over the line and correspond to and reproduce the articulation in the receiving telephone. Any magneto telephone can be used either as transmitter or receiver.

In the battery-transmitting telephone a voltaic current is passed through conductors which are connected to the diaphragm. These conductors offer a certain resistance to the current, and are so arranged that the vibrations of the diaphragm caused by the sound waves vary this resistance with every wave, thus producing undulations in the current, which correspond to and reproduce the articulation. This, however, requires a magneto telephone as receiver.

The battery-transmitter acts more powerfully, for the reason that voltaic electricity is a force much stronger than the magneto electric current when ordinarily produced by the telephone, and on that account the faintest articulation can be transmitted with the utmost distinctness.

It is probable, however, that the battery transmitter will never take the place of the magneto telephone, for the latter is simple in its construction, durable and reliable under all circumstances, can be used for both transmitting and receiving, costs nothing to maintain, is sufficiently loud and distinct and will probably be the most popular instrument for general use.

The battery telephone, though possessing the advantage of louder articulation, and not being liable to get out of order under ordinary circumstances, is more delicate and complicated in its construction, requires the maintenance of a battery in connection with it, the attention occasionally of an electrical expert, and can only be used as a transmitter, thus requiring a magneto telephone as a receiver. It will

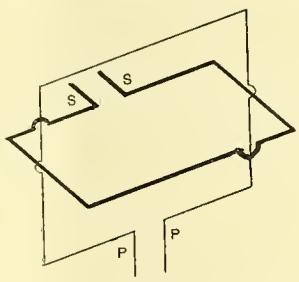



FIG. 16. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

be used principally in the large cities, where the induced currents from telegraph or other wires interfere materially with the weaker currents of the magneto telephone, also in the transmission of messages over long distances, or where, for special reasons, greater volume of sound is necessary to be obtained.

## Lieut. Halpin's Torpedo.

A dispatch from Boston describes Lieut. Halpin's dirigible torpedo and the recent trial at the navy yard. It is explained that the torpedo consists of a thin copper hull, cigar-shaped, with propeller and rudder at one end and a spear-like ram at the other, the forward end. Lieut. Halpin showed the electric motor of four horse power, which turned the propeller and explained how the torpedo itself was wholly independent of the charge which dealt destruction to the enemy's vessel. In the forward part of the torpedo is fitted a metal can or case. When the sphere or harpoon enters an iron net such as a war vessel in these days usually has thrown around it, the meshes of the net strike two projecting arms. This communicates through a rod to a catch inside the torpedo which has held the case containing the charge of 175 pounds of dynamite or a corresponding amount of guncotton or other explosive. The case is released and falls into the water, being suspended by means of a chain from the harpoon head, which becomes detached from the torpedo proper and remains fastened to the net. The charge in the case sinks beneath the net. The contact of the water with a bit of potassium sets on fire a rocket which propels the charge forward and upward so as to rise close against the ship's bottom. The explosion follows within forty seconds of the ignition of the rocket charge. In the meantime the torpedo itself has backed out of way and beyond range of the explosion. It is then free to be guided back to the place whence it started, to be loaded and sent out again.

All this was explained by Lieut. Halpin, who is naturally enthusiastic on the subject, before he turned on the current and set the machinery in motion. The method by which the torpedo is operated and controlled is perhaps the thing most interesting. With nothing in his hand but a ten-inch square board with a pointer and a circle of metal spots and nothing connecting with the torpedo but a small wire weighing only forty-five pounds to the mile, a man can sit or stand on shore or shipboard and by simply moving the pointer on the little board from one spot to another he can run the torpedo at the rate of twelve knots an hour through the water, attack a ship miles away and start the torpedo back to the point whence it started. Just how this is done was illustrated by the lieutenant.

## The Definition of Reactance.[1]

By Prof. H. J. Ryan.

I like the definition of "reactance" as put forth by the authors of this paper.[2] Had we learned to use alternate currents first, this relation between the constant properties of a circuit, the current and electromotive force would first have been understood instead of Ohm's law:

$$\text{Impedance} = \frac{E}{I}.$$

Experience would next have taught us that this impedance relation is made up of two fundamental component relations: the one is a power relation, and the other a wattless rela-

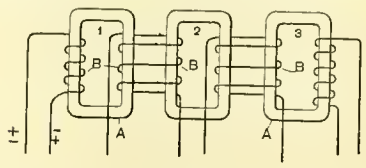



FIG. 17. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

tion. Because of our early familiarity with direct currents we learned long ago to write the power relation as:

$$\text{Resistance} = \frac{\text{power } E}{I},$$

and, now, if we accept this definition of "reactance" the second and equally important component of the impedance law will take the same simple form

$$\text{Reactance} = \frac{\text{reactance } E}{I}.$$

## Government Telephone System.

Bids were opened by the chief clerk of the Interior Department for the construction of a telephone exchange system for the Department of the Interior at Washington on December 18th. The following is a list of the bidders:

Royce & Marean, Washington, D. C., $5,151.01; time, 75 days.

Western Telephone Construction company, Chicago, Ill., $6,165.76; time, 90 days.

Gilliland Telephone company, Chicago, Ill., $5,598.37; time, 90 days.

Gerson Electrical company, Philadelphia, Pa., $2,996; time, 90 days. Bid submitted without guaranty.

Viaduct Manufacturing company, Baltimore, Md., $3,557.50.

## Electrical Fire Department Apparatus in Patent Litigation.

Nathan O. Ross has won his suit in the United States District Court against the cities of Minneapolis and St. Paul for infringing upon the patent of Bragg for electrical and mechanical appliances for releasing horses from their stalls in fire department stations. Judge Nelson filed the order. The suit is one which will attract considerable attention in cities all over the country, as the complainant will probably follow up his suit in other municipalities. Ross is also inventor of a patent appliance for the release of swinging harness. He sued the municipality of Kansas City for infringement and was defeated. But in the suit

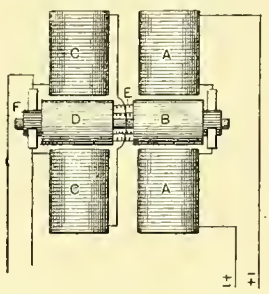



FIG. 18. ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.

against the Twin Cities for infringing the appliance for releasing the stable door, Ross, who controls the patent issued to Bragg in 1876, was successful. Ross has been granted a perpetual injunction in his suit against the Twin Cities and is entitled to an accounting and a reference to a master in chancery to ascertain the amount due. City Attorney Simpson of Minneapolis says that the city will probably have to make a settlement with Bragg under the decision of the court. There are about eighteen engine houses in that city using the appliance.

1. Communication to the American Institute of Electrical Engineers, November 21, 1894.

2. Communication by Charles P. Steinmetz and Frederick Bedell (American Institute of Electrical Engineers), Western Electrician, December 1, 1894.

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## HIGH WATER MARK

CIRCULATION, 16,630.

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CAPITALISTS have great respect for legal decisions, especially those made by the United States courts. That this is true is shown by the fact that the announcement of the decision in the Berliner patent case last week caused an immediate break in Bell telephone stock, a drop from 200½ to 191 following on the heels of the publication of Judge Carpenter's finding. This is all the more noteworthy in view of the fact that the decision is by no means final, and it is fully understood that an appeal will be taken and that all the power and resources of the Bell company will be taxed to their utmost capacity to maintain the validity of the Berliner patent in the higher court.

IN the annual report of his department Postmaster-general Bissell suggests several reforms which he thinks should be instituted. Those grouped under the head of "abuses connected with second class matter" will be of interest to technical societies as well a publishers of periodicals. Mr. Bissell says that so far the publication of fraternal, scientific, educational, trade, professional, literary and historical organizations admitted to the privilege of second class matter, under the act of July 16, 1894, are almost wholly of a mere advertising character, and are, therefore, not of the class to which any exceptional privilege should be given. He believes that the needed reform may be brought about by adopting stricter measures in admitting periodicals. He say: "If it be the policy of Congress to continue the privileges of second class rates to benevolent or fraternal societies, then the remedy I would suggest would be an amendment of the law limiting this rate to them and to legitimate newspapers and legitimate periodical magazines. I believe that one year's experience under such limitations, with the frauds and abuses checked, would demonstrate that we have already reached the time and conditions when all such legitimate newspapers and periodical magazines may be transmitted through our mails from publishers into the hands of subscribers free of all cost."

There is no doubt that societies and educational institutions have abused the privileges extended to them and that newspapers have suffered largely in consequence. It is customary at present to print the proceedings of many scientific bodies, and circulate them among the members and others interested in the special line to which the organization is devoted. In many instances advertisements are printed in these proceedings, thus violating the terms of the proposition which the organizations made when they were endeavoring to get their publications admitted as second class mail matter.

LONG-DISTANCE telephone line installations in Europe are increasing in number. The circuit between London and Paris has been working for some time and is soon to be used in an interesting test of Dr. Gray's telautograph. The line between Vienna and Berlin has been opened, and so large has been the patronage that it is anticipated that a second and perhaps even a third line will very soon be required. During business hours the present line will be exclusively at the disposal of the bourses in the two cities. It is claimed that the present line, which is about 500 miles in length, does not act very satisfactorily. It has been ascertained that the defect is in the line from Berlin to the frontier, whereas the line from Vienna to the frontier works to perfection. While this German-Austrian line is under consideration, it is interesting to note the characteristically English account of the Vienna correspondent of a London journal. This gentleman gossips in this fashion: "Our telephone system would appear to be the best that exists. Whenever an Englishman has watched me use the telephone, his expressions of surprise and delight became quite un-English in their enthusiasm. Not only do we set our watches by the telephone, communicate the latest pun, correct mistakes in pronunciation, but set the boys their work and correct their mathematics on the little desk fixed to the telephone. The ever willing young ladies at the central office often take a lively interest in what is going on, give us pieces of information we might not otherwise obtain, and lovingly ask how we are when we have not called for a couple of days. The telephone in Vienna is perfection, and the connection with Berlin will perhaps have a good effect on the telephone there, which is generally complained of." The idea of calling up a man to communicate "the latest pun" is exquisite.

IN the discussion of Prof. Shepardson's paper before the American Institute of Electrical Engineers, which was published in the WESTERN ELECTRICIAN of December 1st, a number of interesting suggestions are found, although it must be confessed that there were very few ideas of real value advanced. It is quite remarkable that nine men out of ten have no conception of the amount of labor, time and expense involved in the production of an index that would be of any real value to the engineering profession. Admitting the value of a reliable index, it is questionable if the time has arrived when such a work can be begun and carried on successfully. In the first place only a comparatively small number of persons feel the need now of such a work and they would not be willing, if indeed they were able, to support the enterprise. This has been the history of several projects in this line; this drawback is coming to be recognized by those who have given the subject any thought. But it is evident that many of those who discussed Prof. Shepardson's paper gave this feature little or no consideration. One of this class is reported to have made the following suggestion:

Would it not be well for the Institute to undertake the publication of a card catalogue of current engineering literature, including in its scope not only the leading articles in the engineering journals and notices of the papers presented before the various engineering and scientific societies, but also references, in a digested form, of all new books, publications or other matter of importance? The bundles of cards might be mailed at the end of each month.

Such a work as here proposed could only be accomplished properly at great cost and with a thoroughly organized staff of experts. Unless these facilities were at hand the work could not be done properly and would be utterly valueless. Mr. Pope's comments were practical and should be carefully considered. It is not a question of the value of such a work, but the means for accomplishing it. Up to the present time no one in this country at least has solved the problem.

THE subject of providing trolley cars with fenders that will prevent persons struck from going under the wheels, in case of accident, is one that has engaged the earnest attention of municipal officers and street railway men for some time. In Brooklyn particularly, where many unfortunate accidents have occurred—due not to any inherent characteristic of the trolley system itself, but to a peculiarly congested condition of traffic on one or two streets and to the inexperience of the motormen—the agitation for the provision of an efficient fender has been pronounced and widespread. Indeed, the Brooklyn aldermen passed a resolution by which they proposed to create a commission consisting of three of their own number, three representatives of the railroad companies and a seventh man, to be chosen by the six, which should select a type of fender that should be used by all the companies under penalty. This action did not, however, receive the approval of Mayor Schieren, who held, no doubt very justly, that the council had no right to leave the determination of the question to such a commission as was proposed. There appears to be, also, grave doubt as to the legal power of the aldermen to require the use of fenders at all, and especially one of a particular style.

Electric railway men are as eager as any class of citizens—in fact, more desirous, if anything—to throw all possible safeguards about the running of their cars on the surface of the streets in crowded cities. But fenders on the cars have not, up to to this time, proved very satisfactory in practice. The Brooklyn company operating the largest number of cars has, however, adopted a style of gridiron fender which, it is claimed, has done effective work in a number of cases. That a fender can be used which will pick up a person lying on the tracks is exceedingly doubtful at present, since the uneven surface of the streets makes it necessary to place the safety arrangement several inches from the ground. If any device can be provided that will really reduce the liability to serious accident in case a person is hit by a car, the companies should be compelled to make use of it. But at present the chief reliance must be placed on the intelligence and self-possession of the motormen and the pedestrians on the streets.

ASIDE from the direct advantages to be gained by the general public through Judge Carpenter's decision in the Berliner case, should the higher courts sustain his position, there is a distinct and positive gain in the fact that a judge of a United States Court has placed the seal of his official disapproval upon the general policy followed by the Bell company in this matter and has also severely condemned some of its acts. After reading the judge's remarks on the action of the company in allowing the application to be delayed so many years, there can be no doubt as to the view the court took of this policy. He says: "That the unwarrantable delay thus caused was intended by the respondent corporation I can have no doubt. In matters of this consequence involving the whole business of a company of so large capital and engaged in so large affairs, I cannot doubt that they were fully advised, both as to the facts and to the law; and I think 'that their acts were so gross as to forbid any inference except that they dishonestly delayed' the issue of the patent, taking advantage for that purpose of the perhaps excusable willingness of the officials of the Patent Office to postpone the decision of a sharply debated question in which a large public interest was involved, on the chance that a decision of the Supreme Court might supersede the necessity for a decision on their part." Here is a plain statement of fact, and one that will be approved by everybody in the country who is not so deeply interested in the Bell company as to lose sight of the principle involved. But there is another point in this connection which should not be forgotten. Without the consent and connivance of the Patent Office employes or officials the Berliner patent could not have been delayed for such an unreasonable length of time. The judge seems to think that the examiner was reluctant to assume responsibility in deciding the case, but this is no excuse. A public official who is incompetent, or one who shirks rather than perform his duty, should be removed from office. In either case the official could do as much harm as one who was positively corrupt. In fact, if the court is right in the ruling on the Berliner case, the unwarranted delay and final issuance of the Berliner patent was one of the greatest blunders the Patent Office has ever committed. A system under which such practices are possible is essentially defective. In the interest of the public, and in fact in order that confidence may be restored in the department, radical changes should be made at once.

## Theory and Practice in Electrical Engineering.

By J. F. Skeels.

In the issue of the Western Electrician for December 8th there appeared an article on "Theory and Practice in Electrical Engineering," by Rankin Kennedy, containing some very timely thoughts and suggestions, in reference to the three and five-wire systems. The five-wire system, if put up the same as the three-wire—that is, running four dynamos in series—would be practicaly the same, although I believe the practice is to use one machine of 440 volts and a compensator; but the three-wire system is the one generally used, I think, running two dynamos in series and connecting the neutral wire to the junction between the machines.

Mr. Kennedy speaks of serious disturbances occurring upon a slight change of load. Now I have had charge of a continuous current plant during the last seven years. About half that time we distributed by the two-wire system, and our distribution became so bad that we concluded to change to the three-wire. The change was made under the writer's supervision and without the loss of a single night of lighting or changing the details of the wiring in any way, simply dividing the load on the two sides of the circuit by changing one-half of the service line connections. I will say that it was a great improvement over the former plan of distribution. Furthermore, we have had no such disturbances as Mr. Kennedy speaks of. Our difference of load varies from 0 to 20 per cent. of full load, without causing any fluctuation in pressure, and we have no such fluctuation in pressure as spoken of, nor any such rules. My experience leads me to say that no matter how great the difference of load there will be no serious disturbance, nor will there be any great difference of pressure at the dynamos. There may be, however, a big drop in the line owing to the fact that the neutral wire is usually made one-half size of the outside lines, and we also find the running of the neutral back to the junction gives the machines a chance to take care of the difference of load perfectly and they do it. It runs just as nicely as two independent circuits would, and it seems to the writer to be the very best form of distribution where the area to be covered is not too great. The whole country seems to have gone wild over the alternating system, however; but the necessity for transformers and the low efficiency at light loads make the three-wire system preferable wherever practicable. This is not said in a spirit of criticism, but simply giving my experience in the matter.

### Mr. Swinton's Comments.

The following communication from A. A. C. Swinton was printed in the London *Electrical Review*, in which Mr. Kennedy's article appeared originally:

My attention has been called to Rankin Kennedy's article under the above heading, in which he instances Scarborough among places where the adoption of the alternating, in lieu of the continuous current system, cannot be justified.

As chief engineer to the Scarborough Electric Supply company, I must point out that Mr. Kennedy appears to be altogether unfamiliar with the local conditions obtaining in that popular seaside resort.

The municipal area, within any portion of which my company can be called upon to supply electricity, contains some four square miles. It is most irregularly shaped, with an extreme length of nearly three miles. When the company was formed, about two years ago, the best positions for the supply station were most carefully considered. Only three sites in the least suitable were to be found—one, the most central, so far as the business quarter of the town was concerned, was nearly two miles distant from one extremity of the borough, and about 1¾ miles from a point to which we are at present supplying current. This site was also unsuited for cheap access of coal, and in other respects disadvantageous. The second site was even more eccentrically placed, was not large enough for the ultimate requirements, and had other disadvantages. The place finally selected, and now used, is not very far from the center of the municipal area, is near a railway siding for coal, and affords facilities for water for condensing purposes. It is, however, a mile distant from the center of the district where most of our consumers are located, and about two miles (measured along the line the mains have to go) to our present most distant point of supply.

Now, at the present moment, we are supplying the equivalent of 10,330 lamps of 8 candle power. We have spent altogether, including the freehold purchase of two acres of land, the making of a large condensing pond, the erection of buildings sufficient for a much larger output than we have at present, and for machinery, mains, meters, transformers, accessories and formation expenses, about £25,000. We are thus capitalized at less than £2 10s. per 8 candle power lamp connected, which, in any case, would be a very low figure, and especially so when it is borne in mind that we have laid over seven miles of mains, of the most substantial description, and on a scale that will admit of a large increase in the number of lights supplied.

In the light of this information, I do not think that any competent engineer will agree with Mr. Kennedy's view that Scarborough is a place suited for the low-tension system, a view which it seems to me he must have put forward without a sufficient knowledge or consideration of the local circumstances.

In any case it would be interesting to know how he would arrange to supply our consumers on the low-tension system at anything like our low capital cost.

## Important Legal Decision.

The litigation between the city of Chicago and the Hyde Park Electric Light & Power company and the Mutual Electric Light & Power company involved an interesting legal point that is of considerable importance to electric light and power companies furnishing current in prescribed territories. The point at issue is clearly presented in Judge Shepard's opinion in reviewing the case on appeal from the Circuit Court of Cook County, Illinois, which is herewith appended:

The Mutual Electric Light & Power company exhibited its bill for injunction against the appellant, and in the same suit the Hyde Park Electric Light & Power company, which was a defendant to the original bill, filed its cross-bill, also, for an injunction against the appellant.

In accordance with the prayers of both bill and cross-bill a temporary injunction order was granted on each. The effect of such orders was to restrain the appellant, its officers and agents, from interfering with the complainant, and cross-complainant in repairing and stringing certain electric wires which had been cut by direction of appellant's officers.

The order of injunction entered upon the cross-bill of the Hyde Park company is the only one that is before us, for the reason, if no other, that the transcript of the record was not filed in this court within sixty days from the entry of the order in favor of the Mutual company (chap. 70, sec. 24, Rev. Stat., entitled "Injunctions").

The Hyde Park Electric Light & Power company was incorporated in 1888 for the purpose of furnishing electric light and power to the inhabitants of the village of Hyde Park, and in 1889, prior to the annexation of that village to the city of Chicago, it was by ordinance given authority to erect and operate a plant for the transmission of electric light, power and heat, in, through or over the streets, alleys and public grounds of said village.

At that time the western boundary of the village of Hyde Park was the center line of State street, south of Thirty-ninth street, and therefore under the ordinance the Hyde Park company had authority to extend and lay its wires from the east to the center of State street. The annexation of the village of Hyde Park to the city of Chicago did not impair the rights of the Hyde Park company.

The Mutual Electric Light & Power company was incorporated March 28, 1893, for the purpose of furnishing electric light and power to the people of Chicago, and by an ordinance of the city of Chicago, passed March 19, 1894, it was given permission and authority to erect and operate a plant for the transmission of electric light, power and heat, in and over the streets, alleys and public ways of that part of the city of Chicago lying south of Thirty-ninth street and west of the center line of State street.

It will thus be seen that the Hyde Park company was authorized to put up wires to the center line of State street from the east, and the Mutual company to put up wires to the same center line of State street from the west. The distance south from Thirty-ninth street to the city limits is about a dozen miles along State street, and throughout that entire length the territories of the two companies adjoin each other.

By the terms of its ordinance or contract with the city, the Mutual company bound itself to erect and have ready for operation, within one year from the passage of the ordinance, a plant to cost not less than $40,000, and to have a capacity of furnishing electric light for not less than 350 arc lights, and if it failed so to do, then to pay to the city $10,000 as liquidated damages.

Being so situated to each other, and the Hyde Park company having its power house and electric generating machinery in operation, and the Mutual company being without a power house or electric generating capacity, and the wires of the two companies coming to State street, those of one company from the east and the other company from the west, the two companies, on June 7, 1894, contracted together in writing as shown by the abstract of record as follows:

"The Hyde Park Electric Light & Power company agrees to furnish and the Mutual Electric Light & Power company agrees to receive electric current of the constant current variety at such points in Chicago lying along the line of State street, adjacent to the territory covered by the present franchise of the Mutual company as may be hereafter mutually agreed upon, at $5 per month for each watt month of energy furnished, provided the watts furnished shall not be less than 60,000 nor more than 100,000 for each calendar month.

"The party of the first part is to furnish, and the second part to receive, not less than 60,000 watt months of energy each month for the period of eight months and as much longer as may be agreed upon by the parties hereto.

"While this contract is in force A. D. Rich shall be the treasurer of said second party and shall receive all money due second party, and shall pay over to the first party promptly on the 15th of each month the amount due it for electric current supplied during the preceding month. In case of failure of second party to pay, the first party is authorized to discontinue the supply of electric current.

"The conditions hereof shall at all times be subject to the laws, rules and regulations, permission and restrictions of the city of Chicago.

"In case of failure on the part of the second party to pay or perform, first party may at its option determine contract."

On June 13, 1894, a permit by the commissioner of public works to string wires on certain poles belonging to the City Railway company, with the consent of that company, on Sixty-first street from State street west to Wentworth avenue, and so on, was given to the Mutual company; and on July 2, 1894, a like permit was given to the Hyde Park company to string wires on poles on the south side of Sixty-first street from State street eastwardly to South Park avenue, and on the east side of State street from Sixty-first street to Sixtieth street, and eastwardly on the south side of Sixtieth street from State street to South Park avenue, and so on.

It will thus be seen that under the two permits the wires of the respective companies were authorized to be strung to the junction of State and Sixty-first streets, one from the West and the other from the East.

The strict letter of the permit to the Hyde Park company confined its right to string wires on State street on the east side thereof, and the permit to the Mutual company was to string wires "from State street to Wentworth avenue."

It is alleged in the cross-bill of the Hyde Park company that said company did, about July 14, 1894, for the purpose of carrying out said contract with the Mutual company, connect its wires from poles along the south side of Sixty-first street and along the east side of State street to the center line thereof with the wires of the Mutual company, and furnish current to the Mutual company as provided by contract, and did maintain and operate electric wires, conductors and system for the purpose of furnishing a current of electricity for light, heat and power to the Mutual company; and that the city, by its agents, without reason or excuse, and without notice to cross-complainant, on said July 14th, caused said wires and conductors along the south side of Sixty-first street and east of the center line of State street to be cut, disconnected and destroyed, and thereby prevented said cross-complainant from furnishing said Mutual company with electricity and from complying with said contract, and that the city has, ever since said wires were cut, refused to allow them to be repaired and again connected.

The injunction granted, as has before been said, was from hindering or interfering with the Hyde Park company in restoring the wires to the condition they were in before they were cut by the city.

The question presented is one of very great importance, involving as it does the power of an electric light and power corporation, which is limited by the very terms of its grant to operation within a definitely prescribed area or territory, to extend its operations generally and indefinitely into other territory not included in its grant, whenever it shall see fit to contract for that object with other corporations having rights within the additional territory.

The Hyde Park company had no authority under the ordinance of the village of Hyde Park, which contains its only grant of power, to furnish either electric light, heat or power outside of the limits of that village, and the boundary of these limits on the west, which is the direction in which it seeks to extend its right to furnish electricity, was and is the center line of State street.

The permit of the commissioner of the Board of Public Works of the city of Chicago (the successor of the village of Hyde Park) to string wires on poles outside of those limits, even if such were the terms of the permit by any sort of construction, could not extend the grant.

The right to furnish and transmit electricity is the essence of the grant. That alone is the public and useful end to be observed. The poles, conduits and strung wires are means to attain the useful end accomplished by transmitted electricity.

The mere permission to string wires might or might not, according to circumstances, be within the control and permission of the executive officers of the village or city, but the right to transmit and supply light, heat and power, by the powerful agency of electricity, over the streets and public grounds of a village or city rests peculiarly and exclusively in a proper legislative grant. And such grant when given will never be extended except by necessary implication from that which is expressed.

Here is a corporation upon which has been bestowed by ordinance a grant to erect and operate a plant for the transmission of electric light, heat and power through streets within the prescribed limits of the village conferring the grant.

No grant is to go beyond the limits was conferred, not even by permission of adjoining municipalities.

Possessing this grant and operating under it, the Hyde Park company, by contract with another corporation possessing a like grant and privilege within another and different territory, connects its wires, at the line where the territories of the two corporations meet, with the wires of the other corporation and proceeds to transmit electricity over the wires of that corporation into territory within which it has no power to operate, with the same effect and for the same purposes that it operates within its own territory.

In every essential the doing of that is the same as if it had strung its own wires within that foreign territory and had transmitted electricity over them for the lighting and heating of, and furnishing power for, that territory.

Such is a most palpable evasion of the limitations of its grant and is a flagrant excess of the due exercise of its powers.

Public policy, as well as the contractual obligations between the company and the city, is most seriously violated by such methods. The limits of franchises granted by municipalities should not be extended by doubtful implication.

If such conduct by the Hyde Park company should be sustained and it be permitted to thus extend itself into the territory it has thus entered it might by successive connections with the wires of other companies with whom it should contract extend itself all over the city of Chicago, or for that matter the whole state.

The cunning of men to overreach their fellow-men, and the state itself, by contrivances which at first sight seem harmless, but are in reality fraught with dangerous tendencies, can best be checked by a strict and, perhaps, severe upholding of the law.

Counsel have intimated that the contract between these two companies is for temporary purposes only, but that is not the way the contract reads. Its provisions are "for the period of eight months, and as much longer as may be agreed upon by the parties hereto."

The provision in the ordinance to the Mutual company that it shall pay to the city $10,000 as liquidated damages in case it "shall fail to complete such plant within" one year, is quite a mere band of straw so far as the erection of a power house and electric generating machinery of its own is concerned.

"Such plant," when read in connection with the "plant"

that section one of the ordinance confers the power to "erect and operate," may perhaps as well mean poles, wires and conduits as a power house or generating machinery, for which, if the contract with the Hyde Park company should be upheld. there would be no use. The same contract provides for the furnishing by the one company and the receiving by the other of electric currents at all points along the line of State street "as may be hereafter mutually agreed upon."

If this connection at Sixty-first street shall be sustained as lawful, then by the same reasoning as many other connections along the entire length of State street south of Thirty-ninth street as the parties should agree upon might be made, and that such was the intention of the parties to the contract is, we think, apparent.

The city officials performed no more than their duty when they cut the connection between the two companies (King vs. Davenport, 98 Ill., 305), and the injunction restraining them from interfering with a new connection of the wires should have been denied. The cause is therefore reversed with directions to the Circuit Court to dissolve the injunction that was granted upon the cross-bill of the appellee, Hyde Park Electric Light & Power company.

Judge Gary concurred in the decision and the opinion, but inasmuch as it was interlocutory he refrained from going into details.

## French Electrical Work.

According to *L'Industrie Electrique* the conditions under which the electrical industry of France is now carried on are not as encouraging as those which obtain in other European countries. Taking 16 stations, a brief description of each is given with special reference to the duration of the concession, the municipal taxation, price of coal and cost of current per hectowatt hour. In the table herewith reproduced from the London *Electrical Review* half of the towns given are English, and it is remarkable that in four of them the cost of fuel should be so high as compared with all the foreign towns excepting Milan. At the same time the Milan undertaking, with coal at 33.67 francs per ton, returns 10 per cent. of a dividend. True its price is high, nearly tenpence per kilowatt hour, but at Dusseldorf, where the price is tenpence and coal only a third the price it is at Milan, there is no dividend at all, nor is there at Breslau, where conditions are about the same. No information appears which explains why this is so, but one must, of course, not judge from the apparently high price that this really seems high to people who have, perhaps, been paying dearly for gas. Again, in Geneva, where water power is utilized, a price of sixpence admits of no dividend.

The Manchester undertaking is too recent for any dividend to have been declared, but it is given as an example of a recent undertaking carried out with the full benefit of all previously acquired experience, and showing the amount of capital necessary for such enterprises at the outset, namely, £129,300 for 28,000 lamps, which may be compared with the Westminster company's £381,000 for 76,700 lamps. Attention is drawn to the fact that with all the perfections of the Manchester station that have been brought about by experience, the cost of producing electric energy is almost the same as at other stations where, coal and labor are also equal.

| City. | Population. | Equivalent number of 16 candle power lamps. | Years of concession. | Municipal tax, per cent | Price per kilowatt hour | Price of fuel per ton. | Last dividend, per cent |
|---|---|---|---|---|---|---|---|
| | | | | | | s. d. | |
| Vienna ..... | 1,400,000 | 25,000 | 50 | 3 | 9d. | 16 8 | 2 |
| Dusseldorf.. | 193 000 | 18,300 | perp'tl | 0 | 10d. | 9 2 | 0 |
| Breslau. | 354,350 | 15,118 | perp'tl | 0 | 9d. | 8 11 | 0 |
| Berlin .... | 1,710,000 | 19 ,000 | 30 | 10 | vari'ble | 17 11 | 10½ |
| Liverpool ... | 600,000 | 29,000 | 42 | 0 | 7½d. | 8 4 | 5 |
| Manchester | 515,508 | 28,000 | perp'tl | 0 | 8d. | 8 4 | ? |
| Glasgow ... | 750,000 | 26,550 | perp'tl | 0 | 6d. | 8 8 | 3½ |
| Birmingham. | 500,000 | 12,000 | 42 | 0 | 7d. | 8 8 | 4 |
| Westminster | ? | 76,700 | 42 | 0 | 6d | 19 8 | 4 |
| Oxford..... | 50 000 | 5,500 | perp'tl | 4½? | 7½d. | 21 9 | 0 |
| St James... | 241,993 | 99,000 | 42 | 0 | 5½d | 20 3 | 4½ |
| House-to-House... | ? | 20,326 | 40 | 0 | 7½d. | 20 - | 0 |
| Milan. ..... | 433,324 | 31,821 incan. 957 arc | perp'tl | 0 | 9.6d | 28 6 | 10 |
| Geneva . ... | 72 000 | 15 000 | 8 | 0 | 6d. | water | 0 |
| Lausanne.. | 33,000 | 000 | perp'tl | 0 | 18d | ..... | 0 |
| Copenhagen | 226,000 | 25,800 | perp'tl | 0 | 8½d. | 11 2 | 0 |

Of the 16 undertakings in the table, eight only have been able to return a dividend on their last working period, and a general review of these large concerns shows at a glance that the electrical industry is not very prosperous, even outside France. This, too, despite the advantage of large capital and newness of construction, excepting only the Société Suisse, which is the oldest in Europe. All of them, too, except the one at Milan, have longer working hours than is the case in France—that is, the duration of the load period is greater. Foreign enterprises, also, are seen to be more favored in respect of fuel cost, seeing that the price varies from 11 to 24.35 fr. per ton as against 32 fr. in Paris. But there is another cause, viz., the duration of the concession, which is, at least, 42 years, and in many cases perpetual, while in France it is much less; in Paris only 18 years' concession is given. Foreign municipalities, also, do not take a tax on the receipts, whereas this is the rule in France, and amounts, in Paris, to no less than 5 per cent. of the gross receipts, in addition to certain controlling costs and a rental charge of 100 francs per kilometer of line. Even without taking account of the difference in fuel cost for the Parisian companies, the inequality of the duration of the concession has an enormous effect, as it is easy to show, for it is necessary to levy an annual charge on income (when, adds our contemporary, there is one) sufficient to return to shareholders their capital at the end of the concession period. Had the original capital been unchangeable and sufficient to carry through the period of concession it would have been simply necessary to pay off a fixed sum annually, but, instead, the companies have called new capital to satisfy the wants of their new subscribers. The amortisation of capital calls for an annual charge almost in inverse ratio to the duration of the time over which the payments are spread. Thus, at 5 per cent. interest and a period of 18 years, £1 will demand an annual charge of 1.711 shillings, while with a 9 years period the charge becomes 2.814 shillings. Thus it is that French enterprises are placed in a position of inferiority that cannot be gainsaid, and this is the more to be regretted in that if three of the Parisian companies have paid a poor dividend by charging for current a price too high for the bulk of consumers, the other two are working at a loss.

The clauses of the agreement of 1888 were fixed by the municipal council in the belief that electricity had a grand future, and would overturn everything; but they were mistaken, for electricity has superseded but little, simply because of the high price of current, and affairs will remain so till such time as more perfect means of utilization and transmitting current admit of better returns. It is, therefore, necessary that, as a young industry, electricity should be assisted and untaxed, and those who have been instrumental as pioneers might then hope to draw some little revenue from their hitherto unproductive property, which is designated by *L'Industrie Electrique* as a mine of metallic copper under the streets of the great cities of Europe.

If there is anything to be learned from the table, it is that selling price and fuel cost are by no means the chief factors in the equation determining the figures in the final column.

It would appear that French electrical enterprises are now suffering from the extravagant claims once put forward for electric lighting, the result having been that only short concessions, saddled with onerous charges, have been granted to the companies, and practical working has demonstrated the impossibility of profitably working under such heavy loads. In the case of Manchester and Oxford it is believed incorrect figures have been secured, Oxford, with its 5,500 equivalents of light, the cost of installation and mains being given as £116,600, as against a cost in Manchester of £129,300 for 28,000 equivalents.

## American Electric Railway Practice.

At a recent meeting of the Institution of Electrical Engineers at London the subject of electric railway practice in the United States was the chief topic discussed.

N. S. Keith of California was invited to open the discussion. He gave a short description of a plant in California, in which a grade was ascended of 1,600 feet in 3,000 feet by means of electrical power. This was the Pasadena and Mount Wilson railroad, in the southern portion of California. The line ran from Pasadena, and would eventually end on the top of Mount Wilson, some 13 to 15 miles away, at an elevation above the sea of 7,000 feet. The line was completed a year ago last July to the top of Echo Mountain, 3,500 feet above the city of Pasadena, which was some few hundred feet above the sea level. For a distance of four or five miles the grade is a very uniform one of about 7½ per cent. It then went up to a grade which necessitated an ascent, as far as he remembered, of 1,600 feet in 3,000 feet. This ascent was made by a cable run by a 75 horse power Keith electric motor, placed on the summit of the rise. There were two cars fixed upon it at equal distances on the cable, so that when one ran up the other ran down, and they thus balanced. The cars were so constructed that the seats were upon a level, or ran horizontally; the inclination was one of 45°. The motive power was a 75 horse power motor, receiving its current from two sources. At a small town half way between this severe rise and the town of Pasadena were located two 60 horse power gas engines. At various localities in the mountains above were placed dynamos driven by Pelton water-wheels, very small quantities of water having a great pressure playing tangentially against a radial box upon wheels. This was a necessity, because the quantity of water available for water power was insufficient. It was contemplated, and would be carried out by the time the line was completed to the top of Mount Wilson, to derive a quantity of water from the other side of the mountain; 400 feet below the summit of the mountain there was a small stream flowing. It was in contemplation to pump this water for 400 feet by electrical power, allowing it to fall on the western slope of the mountain, where it had a descent of 7,000 feet. Two or three hundred feet in excess of the 400 would ensure the production of sufficient power to run the pump and motor, leaving, then, some 4,200 or 4,300 feet fall for power purposes.

Mark Robinson said a few words on the commercial aspect of the papers. Electric traction, he believed, was going to be a matter of magnitude very few of them were able to gauge, to the great benefit of engineers and electricians as well as to those capitalists who built the lines and the public who would use them and profit at least as much. Not forgetting the good work done in Germany and other Continental countries, and the really remarkable traction works in England, which, unfortunately, were limited in extent, he thought they would all allow that the country which could teach them most in electric traction was America. In the last session they had the general progress of electricity in America sketched for them by the master hand of Mr. Preece; now they had the hand of a younger electrician, who had utilized his stay in that country to report the progress in one particular direction. It should be very gratifying to them that not only did their American friends lay their experience and knowledge open to Mr. Wilkinson as an individual, but also avowedly placed them at his service for the purpose of laying the results before this Institution. Then they had an American engineer coming to them and laying before them fully, and, as far as he (the speaker) could judge, without any reservation at all, not the general facts of car traction, but those important details upon which success depends, the "how to do it" and the "how not to do it," which they wanted to learn. Messrs. Blackwell and Dawson's paper struck him as being very restrained and very free from self-seeking. Their display of apparatus seemed to his colleague and himself so interesting that, having friends in France at present engaged on a large traction scheme, they thought they could do them no better turn than to ask them to come over and be present at that meeting and see that collection of apparatus. Although those gentlemen, owing to the curse of Babel, were not able to join in the discussion, they said they were rewarded for coming over by the inspection of the very interesting apparatus. As one of those who confidently expected very great advantage from the certainly imminent development of electric traction on a great scale, he begged to tender his thanks to the authors.

H. F. Parshall said he had listened to the papers on American tramways with unusual interest, primarily, because he had designed a great amount of the apparatus that was at present used in the United States, and, secondarily, because he was always desirous of finding out whether British engineers had noticed anything peculiar to American tramways, as very frequently they did notice things peculiar to their various other institutions. Perhaps one of the most important points was with respect to the earth returns. As was commonly known, they were experiencing a great deal of difficulty in the United States. He might say, as a result of rather a close study of the troubles there, that they might have been avoided at the start if the engineers had carried out the works upon the principles which were thoroughly well understood, and not difficult to follow, as they knew the connection between the rails was made by bonds and pressure contacts. Now, they had had quite a definite experience with pressure contacts in their central station practice. They knew the folly of having copper surfaces brought into the most intimate relations and at comparatively high pressures—about 300 amperes per square inch was the highest they could work on, even when there was an entire absence of oxidization. Underground they had the contact between copper and iron, and seeing that in a central station they did not go over 50 amperes per square inch, he did not know why they should expect to do so in the case of tramways, where in many cases there was not less than 1,000 amperes per square inch. This was an immediate source of trouble. The matter could be entirely eliminated by simply proportioning the section of the contact between the rail and the bond to suit the current that was to be carried. If they had 1,000 amperes per square inch as the mean value in the bond, then the contact between the rail and the bond should be 20 times the cross-section. For the larger stations such as they were installing in Brooklyn, where the current output was 12,000 or 15,000 amperes on the average, and 600 volts, the amount of contact surface became enormous. This trouble they were overcoming very largely by electric welding. They put in a sort of auxiliary plate and electrically welded it to the rails. With this, so far as had been ascertained, there had been no trouble. In fact, he was inclined to recommend an electrically welded underground system everywhere where it could be afforded. The next point he thought English engineers would be interested to know about was the amount of power taken by an ordinary car under what might be considered average working conditions. He could state as the result of a great many experiments, that the amount of power under approximately the same conditions, varied directly with the number of stops; but under ordinary frequency of stopping, it was one Board of Trade unit per car mile, which was usually regarded as a fair value. A further interesting fact with regard to the amount of power was that the watts per car mile remained approximately constant over a wide range of speed. From this they could draw the interesting conclusion that the watt output of a station was proportional to the number of car miles. With the series parallel method of control the force for starting a car was about 60 pounds at the periphery of the car wheel per ampere. With 50 amperes, or a force exerted at the motor corresponding to 3,000 pounds at the car wheel under ordinary conditions, the car would accelerate at the rate of two feet per second. This was, he thought, quite as fast as was desirable, especially with people on the tops of cars, corresponding to the people standing up in American cars. With the series parallel motor, where the stops were frequent, there was a decided economy in having two motors per car. Where the stops became infrequent, say at every half mile, then the single motor, with rheostat control, compared favorably in efficiency with the two motors in series parallel control. Speaking of speed, he was reminded of the somewhat stringent rules that obtained in England on the matter, and he might say that their practice in the states was roughly that, in the crowded thoroughfares, the car speed was about three or four miles an hour, and in the least crowded thoroughfares, the suburban streets, as high as twenty miles an hour; but the number of people killed, as most always happened, was inversely as the car speed. That was to say, they killed the people on the crowded streets, where the cars were moving slowly. He should like to point out first with regard to this slow speed, that it necessarily increased their investment in cars and motors 50 per cent. for a corresponding number of car miles in the states. As a secondary point the application of electric traction was limited—that was to say, its usefulness was limited—on account of the rule in regard to the outlying districts; it simply lessened the efficiency of the whole thing as an investment to the extent of 25 or 30 per cent. Still, as the statistics they had gathered from the roads in Great Britain showed, there was a satisfactory margin left, and the only point was whether or not engineers should not be able to demonstrate to the satisfaction of the Board of Trade that they might safely drive their cars faster in the less crowded thoroughfares. A point once more brought up in the paper read that night was with respect to the application of alternating currents to street car motors. He was perfectly familiar with the work done on both sides of the Atlantic in the development of alternating currents, and he knew of the work accomplished by Mr. Brown, but he did not see that it left any hope for expecting the adoption of polyphase motors for car traction. The three-phase motor was the only one that approximated to their requirements, and

as that had less torque than the series parallel control it was out of the question: it required approximately equal inductance and resistance in all of the branches. In other words, it wanted a resistance of the earth circuit, which he imagined was rather beyond the engineering of the present day. His next point was with respect to directly connected generators, and their experience with them in the United States. At the World's Fair they made their first grand exhibition from their standpoint with 750 and 1,500 kilowatt directly connected machines. They were to operate the intramural road, in which there were 14 trains, 67 tons per train. The average power taken per train was 42 kilowatts, but the maximum frequently exceeded 300 kilowatts. It was found rather more economical to operate a road of this size with a 750 kilowatt machine. He had at hand the report of the chief engineer in charge of the road, and also the speed and current curves taken, and would be glad to show them to members. An interesting point brought out was that the managing director of the road complained to the engineer in charge of the interruption of service caused by the opening of circuit-breakers. The man, with characteristic Yankee ingenuity, or the lack of it, simply plugged the circuit-breaker, and his statement to the speaker was that when the crowbar was placed across the earth return, it either rolled off or was burned off. The strain on the engine was most severe. The engines were taken down at the end of the exposition, and were found to be in perfectly good condition, so that he judged the mechanical stress brought upon this class of apparatus had no serious influence on the durability of the engine. He might state in conclusion, with reference to the future practice in the United States, and, he hoped, in England, that great fluctuations in power should be avoided. By carefully studying the point, he thought engineers could avoid it. There would be a direct advantage in every respect. The principal one would be the decided gain in economy. The smaller steam engines could be used, and engines worked under average conditions at their most economical horse power. This was what they were striving to do in the states at the present time, but he did not think they were as successful in accomplishing it as were engineers in Great Britain, with their more carefully ordered way of proceeding about engineering matters.

## Electric Traction.[1]

This subject seems to be at the present time the most interesting one in electrical engineering, and many engineers are strenuously working for its adoption and success in this country. We sincerely hope their efforts will result in its extension to a very large degree.

A paper on this subject by C. S. Du Riche Preller, M.A., read before the Institution of Electrical Engineers, gives us an idea as to the extent and usefulness of electrical traction methods in Europe for working steep grade or mountain railways.

First, in regard to cables worked by stationary motors, of which three examples are very briefly described. It will be noted that they are all worked by exceedingly cheap water-power, hence the economical working, but we cannot get water-power everywhere, and even in some cases where it exists, and could be used, the terms upon which it may be utilised are so exorbitant as to become prohibitive; for when the owner of a large waterfall learns that it can be employed to work a railway he naturally begins to calculate upon its value to him, and looks upon it as a valuable property, and no longer as water running to waste.

The author of the paper, without the least attempt at an explanation of his meaning, states that the total efficiency of these cable traction electric railways is 60 per cent. Such a statement requires some explanation as to how it was arrived at. A single motor, a dynamo, or an engine, may be said to have an efficiency of 60 per cent., and we know exactly what is meant. But without the most precise information as to how the efficiency of a complex system is obtained, the simple figure stated is valueless.

We emphatically protest against this loose practice when reading papers before engineering societies, of putting forward figures which are only estimates, instead of actual ascertained results. If only estimates can be given, then we must insist upon having a clear statement of the methods upon which they have been based.

Whatever this 60 per cent. may mean, it cannot possibly mean the total efficiency as usually understood by that term; and as many discussions are about to take place on electric traction, it may be well once for all to define our ideas on total efficiencies, especially in regard to this particular topic.

An electric railway comprises many different machines for transforming and transmitting energy. A prime mover, a dynamo-electric machine, a system of insulated conductors, a moving electro-motor or stationary motor, regulating resistances, and gearing between the motor and the locomotive or car. These are the elements of an electric railway, and there are only two ways to arrive at the total efficiency of such a combination. First, we must measure or estimate the efficiency of each element separately, and add up all the losses to get the total efficiency. Secondly, we must measure the total input of energy at the power house, and total output on the car or locomotive axle, an exceedingly difficult thing to do, and one which, we believe, has never been done in practice.

But we can approximately arrive at the total efficiency by calculating from the well-known efficiencies of the elements of the system, for although it is almost impossible to measure the total input and output, we can easily find many determinations of the efficiencies of the separate elements.

In these cases of water power quoted, we cannot allow a higher efficiency for turbines than 80 per cent.—a very high estimate—then the gearing between the turbines and dynamos must account for at least 5 per cent.; the dynamos, if worked constantly at full load, would waste 10 per cent; but on an electric railway, as the load varies largely, there will be a further loss, about 15 per cent. or more. In the case of the Burgenstock line, after incurring losses in the power house, the remaining energy has to be carried 2.5 miles to the motors. If the author of the paper had given the fall in pressure on the line, we could have found its efficiency; but it is safe to assume that another 5 per cent. would be lost on the way, and probably as much as 15 per cent. may be lost. What is now left of the power is delivered to the motor, which, running at varying speed and load, wastes from 10 to 30 per cent. again. The power is then passed on to the cars through gearing and cables, and these, judging from cable haulage experience, will take at least another 20 per cent. of the power; and what is now left is that actually usefully applied to the work, and we dare say if all these losses are added up, and deducted from the input, that the 60 per cent. efficiency is far too high an estimate of the actual total efficiency.

Throughout the paper total efficiencies are given as 58, 62, 65 and 68 per cent. for different railways, but we cannot accept any of them as correct, for with the plants described in the paper they are impossible figures. The number of transformations of energy, and the amount of gearing it has to pass through, not to speak of the losses in motors running at variable speeds, and regulated by resistances, would account for far more than a loss of 40 per cent.—70 per cent. would be nearer the mark. In a paper of this kind, where details accurately ascertained (such as pressures, currents, resistances, horse powers and curves of performances) are not given, the less said about efficiencies the better; without these the figures can be taken only as the result of guesswork. It is more important to learn from the paper that whatever the total efficiency may be, the lines described are all successful in every respect, for this proves that the advantages of electric traction, even at the present day, are great enough to counterbalance the losses, whatever they may be.

Belt driving is said to be preferable to direct driving for railway work, owing to the great fluctuations in power required. There is probably some truth in the argument, which amounts to saying that the belt introduces some elasticity between the engine and dynamo, which considerably softens the shocks occasioned by the sudden rises and falls in the load. But this is a question which experience alone can decide.

Accumulators or storage batteries are recommended as a remedy against the fluctuations in load, and the installation at Zurich is quoted as an example, but no facts or figures are given in support of the statements. The Isle of Man tramway is quoted as another example of the use of accumulators, but the Isle of Man case is of no value yet as an example. It has not worked long enough, and no results have been published by which its success can be judged. There is nothing new in applying storage; every engineer ever since storage became possible has held storage to be of paramount importance in every installation, whether for light, power or traction. But it is futile to talk of the advantages of storage while the means at our disposal for storage of electrical energy are so limited.

We do not think the alternate current motor is yet perfect enough for traction work, but there is little doubt that if the primary obstacles to electric traction in this country were once overcome so that the business could develop, suitable alternating current motors would be forthcoming.

Multiphase motors might at present be used, but the introduction of a third insulated conductor is both expensive and complicates the system of collection; they have, therefore, not been used except in an experimental way. If storage has any advantage in a traction system, it would be entirely lost in an alternating current plant, and no alternators yet designed could regulate quick enough to keep in step under the violent fluctuation in load. When we come to seriously consider the alternating current for traction, we find that there are disadvantages as well as the advantages mentioned by the author of the paper, and it is well to look at both sides of the question before agreeing with him that the alternate current is destined to supplant the continuous current in traction work. This is one of those questions upon which it is never safe to prophesy unless you know; it is very questionable whether alternating currents will supplant the continuous current even for lighting purposes. The trial is not at an end yet.

1. From the London *Electrical Review*.

## Color Making by Electrolysis.

The principle of electrolysis is finding commercial application in directions which were scarcely dreamed of. An English contemporary names several efficient processes for manufacturing chemicals which are in active operation. One of the latest of these consists in producing Prussian blue and Berlin green. Prussian blue, otherwise known as Paris blue or Berlin blue and Berlin green are well-known and widely used pigments, and with the competition set up, now that it is possible to make them electrolytically, these useful colors should become much cheaper. The process by which they are made, and which is due to H. Goebel, consists in precipating a solution of yellow prussiate of potash by means of a ferrous salt, such as green vitriol, suspending this precipitate in water, and then subjecting it to electrolysis. It is stated that Prussian blue of an extremely vivid violet "reflex" and coppery luster is obtained. Sulphuric, hydrochloric, nitric or phosphoric acids may be added to the electrolyte, so that it may contain 1-20 per cent. of acid. The precipitate is introduced in the immediate neighborhood of the anode, the contents of the anode compartment being kept well stirred, as well as those of the cathode compartment. The hydrogen liberated is taken up by manganese peroxide or by organic nitro-compounds. When the electrolytic action is protracted, the blue color becomes more and more faint and ultimately changes to a dark Berlin green.

The creditors of Elmer D. Roberts, a small electric supply dealer of Racine, Wis., who failed on November 10th, held a recent meeting in Chicago. Mr. Roberts submitted a proposition to pay 50 cents on the dollar, which was finally agreed to. The creditors represented were the New York Insulated Wire company, Metropolitan Electric company, the Central Electric company, the Buckeye Lamp company, the American Reflector Light company, Williams & Schraeder, and Kohler Brothers, all of Chicago, and the First National Bank, the Commercial Bank and the Racine Hotel of Racine, Wis.

## Mirrors of Magnetism.

In a recent paper by Prof. S. P. Thompson and Miles Walker, before the Physical society of London, on "Mirrors of Magnetism," it was pointed out that corresponding to the theory of electric images produced by insulated conductors, there is a theory of magnetic images produced by bodies of infinite magnetic permeability. A magnet pole in the latter theory is the analogue of an electric charge in the former and a body of infinite magnetic permeability is the analogue of an insulated conductor (which is electrostatically indistinguishable from a body of infinite dielectric capacity). Experiments were made to determine how far the magnetic images due to thick sheets of iron accorded with those deduced by theory for the case of infinite permeability. The image of a north pole in an infinite plane sheet should consist of a south pole of the same strength at a point coinciding with the optical image of the north pole, together with an equal north pole distributed uniformly over the surface of the infinite sheet, as a free electrical charge would be, and so exerting no finite action. Working at distances of a few inches in front of the surface, a sheet of iron a few feet in length and breadth and a couple of inches thick was found to realize the theoretical conditions with very tolerable exactness. In a coil of wire placed on one side of the sheet, a current was started or stopped, and the electromotive impulse produced in a subsidiary exploring coil was detected by means of a ballistic galvanometer. That the effect of the actual mirror was equivalent to that of the theoretical image was verified by substituting for the iron a coil equal and similar to the first and coinciding with its optical image. Sending the same primary current as before round the two coils (with due regard to its direction in the second coil), hardly any appreciable difference in the secondary impulse was observed. This was found to hold good whether the original primary coil had its axis perpendicular or oblique to the plane of the magnetic mirror. Some observations on spherical sheets were also recorded, but in this case the conclusions were less simple.

## Car for Snow Fighting.

A local paper describes a snow-fighting car devised by Superintendent Scheidler of the Newark, O., electric railway lines. The superintendent metamorphosed an old horse car in the following manner:

Taking out the seats on the sides, he built two boxes, one on each side, the full length of the car. The boxes are intended to be filled with salt, and in the center of each box is a hole running through the bottom of the car to let the salt through on the track. An iron pipe reaches from the bottom of the car to within six inches of the track and a rubber hose is attached to this and reaches within one inch of the track. A stick is used to punch the salt through the hole as is needed. Along the car, running clear around it and coming to a sharp point at both ends, is an inch board about a foot wide reaching to within four inches of the track, and to this is an extension that will be used principally on the Granville line that comes within two inches of the track. Right back of this board is an iron scraper that reaches to the rail, and back of this is a broom that also reaches to and sweeps the rail, thus making altogether almost a complete machine to clear away the snow. The arrangement made to put the salt on the track is about the best part of the outfit. The car is intended to be put ahead of the motor and thus a clear track is easily made.

## Responsibility of a Motorman.

"I have been all through the war," said a grim-visaged old motorman on a Girard avenue trolley car to a reporter for the *Philadelphia Record*, "but sure as I live my feelings on going into a battle were pleasure as compared to the dread of killing somebody which fills me the moment I grab the brakehandle of this car every morning. I can't explain why, for I haven't had an accident of any kind since I took the job, but it may be due to the fact that we are so strongly warned to be careful, and, in case we do run down some unfortunate, to get the names of as many witnesses as we can. I would sooner hold the reins of my old pair of nags at less money than be a trolley motorman," concluded the serious-faced veteran as he suddenly applied the brake to allow a party of school children to cross the street in safety.

## Electric Railway Block System.

The Chester, Pa., Traction company has placed in operation a block system for the purpose of showing how far ahead of the car the track is clear, and thus prevent collisions. For the present a block post will be planted at Seventh and Potter streets. The system consists of three separate banners, of different colors, operated by electric motors from a rail contact. At night different colored lights will be used. Rear-end collisions are impossible when the signals are obeyed, and in the case of the Chester Traction company the signals will be especially valuable at the junctions of the branch lines.

An organization known as the Natchez Electric Street Railway company has just been formed in Natchez, Miss., with a capital stock of $100,000, with the privilege of increasing it to $250,000, if necessary. The object of the company is to build, operate and maintain lines of electric railway through the streets of the city and suburbs. Some very wealthy men are named as being connected with the enterprise, and it is thought that they mean business.

## American Institute of Electrical Engineers.

On December 19th Ludwig Gutmann read his paper "On the Production of Rotary Magnetic Fields by a Single Alternating Current" before the Chicago branch of the Institute. This important paper is given in full in this issue of the WESTERN ELECTRICIAN. In New York the paper was read in abstract and the discussion opened by Dr. M. I. Pupin and continued by Messrs. Wolcott, Kennelly and Burnett.

At the meeting of the council in the afternoon the following named associate members were elected: F. S. Blackall, New York city; G. DeRyckere, Grand University, Belgium; Harry E. Dey, Brooklyn, N. Y.; George Wallace Graham, Brooklyn, N. Y.; Vance Lane, Omaha, Neb.; Henry Ackley Lardner, State College, Pa.; Percival Robert Moses, New York; Charles A. Pratt, Chicago; Louis Privat, Chicago; John C. Shedd, Marietta, O.; G. Hamilton Vanderslice, Pittsburg, Pa.

The following named associate members were transferred to full membership: Henry G. Reist, Schenectady, N. Y.; E. W. Trafford, Richmond, Va.; Henry Jackson, Horwich, Bolton-le-Moors, Lancashire; William Frederick Blakeway Ronquette, New York; Fritz Uhlenhaut, Jr., Philadelphia, Pa.

## Suggestions for an Index of Engineering Literature.

In the discussion on Prof. Shepardson's paper before the American Institute of Electrical Engineers on this subject, Ralph W. Pope related his experience in this line and gave some interesting reminiscences. Not the least important was an account of a former effort by the organization to compile an index such as is now suggested. Mr. Pope said:

As the index formerly published by the Institute has been referred to, it may be of interest, at least to some of the more recently elected members, to know why the work was undertaken and why it was suspended. The matter was brought up in council about seven years ago by Mr. Mailloux, and the proposition at that time was that it should be done by the secretary. I had never done any indexing of the kind and that was one reason why I did not undertake it. I have been very glad since that I did not assume the responsibility. However, we had a member, who kindly undertook the duty and it was carried on for some time, until I think it became too much of a burden for him, and it was dropped. I do not know whether at that time I had heard of the experience of two Philadelphia editors. Pehaps Prof. Houston may know something of it. They were equal partners in a daily paper, and one of them had secured the advance sheets of a serial novel which he proposed to publish in daily installments. The editors did not agree upon the question as to whether their readers wanted this kind of mental pabulum, and after it had gone on a week or so, they had a little tiff as to the expense, and whether the people wanted it, and finally they compromised, the editor who objected to it saying, "Let us drop it out, and if we have a complaint from any of the subscribers that we have not finished the story, why I will submit to your idea and we will go on and publish the story to its conclusion." So they actually dropped it, and they waited a week or two and not hearing a word from anybody, they concluded there was no general interest in the subject. I felt that way about our index. At that time, of course, we had only three or four hundred members and perhaps the need of an index was not appreciated at that time as much as it is to-day. I might add incidentally, also, that the proposition was made that the index be printed on one side of the leaf only, so that members who desired could cut it up for their card catalogues. Of course that would add considerably to the expense when we came to print 500 copies, and I cogitated over it a little, and suggested another plan that if any member wished to cut it up for a card catalogue we would supply him with an extra copy for that purpose. I thought that would be cheaper than to run a whole edition printed on one side. We had three applications for an extra copy to cut up, and those were furnished to the members who asked for them. I mention this because the printing on one side is suggested by Prof. Shepardson, but it is proposed to apply a little salve in the shape of advertisements, on the other side that would perhaps pay the extra cost. But what I was going to say was that taking this into consideration, and also the experience of the Philadelphia editors, I thought I would wait and see if anybody complained because we did not continue the index. I believe no inquiries were made. Possibly the members thought it was all right, and that we had good reasons for dropping it. Later this subject has been brought up, and my advice has been asked by one of the editors who was referred to to-night, who inquired what I thought of such a publication as a commercial venture. I told him that my experience was that there were a few people who wanted an index of this kind, and wanted it very badly. But I didn't think they wanted it sufficiently to pay the expense of getting it up. That is to say, there was a limited demand and perhaps that limited number who wanted it would be willing to pay a pretty fair price, but at the same time they would be willing to pay but a small proportion of what it actually cost to compile and print, and that is one reason why it has not been a successful financial undertaking. There were some other points about it that I brought up at the same time. One was this, that there are a great many engineers, not only in the branch of electrical engineering, but other branches as well, who compile their own indexes and have their own ideas about what they wish a catalogue to be, and therefore an index compiled by others, unless it was thoroughly complete, might not satisfy their wants. That is to say, each man feels that if he runs the index himself, he would know exactly what he wanted, and he could discard what he did not want, and a man who was very thorough and very particular would not have that confidence in the work of others which would lead him to throw up his own and take that of somebody else, especially if he doubted its permanence.

There is another point about an index of this kind which is worthy of consideration, and that is that, like some other things, it improves by age. An index that is only a few days old does not amount to anything; but after it has been kept up for five or ten years it begins to become of greater value, and, if the man who undertakes it is patient enough he may arrive at that time in the course of his life when he will meet with his reward. But the difficulty is that few of us are willing to keep on till that time. We get tired, as some of our friends have confessed to night, with shuffling these cards and going over these papers. Perhaps my early experience in making literary scrapbooks was one of the reasons why I refrained from taking up indexing. Those scrapbooks are something over twenty years old now, and occasionally when I do not feel first rate I get out one of those scrapbooks, and am thankful that I was so industrious in my younger days.

Then, again, an index for the public, as it were, should, of course, be general and cover all branches. It would be necessary, I suppose, to classify it in some way; but, in order to meet the general market, it would have to cover all branches of electrical engineering, at least. I ran across, in the English paper called *Industry*, a few years ago, a reference to the first use of electric welding by Siemens in the Siemens factory in welding the iron wires of an armored cable, and this reference spoke of its coming up in a discussion before the Iron and Steel Institute in 1887. The date was given, and all the particulars about this use of the process; and I thought it was a very interesting fact. So I went on a search for that and found the discussion at the very meeting of the Iron and Steel Institute, but could not find a word about electric welding. Now, a good index, I presume, would have brought that to my attention; but I could not find it.

Associations of this kind exist for doing a certain class of work that is of interest and value to the members, but which will not be undertaken by any person or firm as a commercial venture. This question has come up many times in regard to certain papers that have been published in the transactions, papers that are of value as works of reference and which many of our industrious editors abstract or squeeze out altogether, but which some one should publish; and it appears to me that that is one of the missions of a technical society—to do work in a co-operative way which is of benefit, perhaps, not to all the members, but to a few of the members; and the few that are not benefited this time may be benefited next month or next year. So that the mere fact that work of this kind is not financially profitable should not debar the Institute from undertaking it if it is considered of value to the membership.

The question of co-operation with other societies was brought up by Prof. Shepardson, which is worthy of some attention. My experience has been that it would not be worth while to undertake to co-operate in this way. I believe that we should go on with our own work and keep as close to the line of electrical engineering as possible. Of course we must wander over into the line of mechanical engineering and steam engineering to a certain extent. But, in undertaking it, I think that it might be well to propose a system which would meet with the approbation of the other societies, so that, in case they should undertake something of the same kind, the work might be conducted on the same system, so that any person who is interested in all branches of engineering could combine the three as systematically as possible.

A committee was appointed by the council to consider the question of an index of electrical literature. The committee is composed of Prof. F. B. Crocker, chairman; Edward Caldwell, A. E. Kennelly, Prof. W. M. Stine and Prof. George D. Shepardson.

# CORRESPONDENCE.

## New York Notes.

NEW YORK, December 20.—On Tuesday the extensive isolated electric lighting plant in the store of Hilton, Hughes & Co. was completed. This is one of the largest private plants in the country, having a capacity of 12,000 incandescent lamps. There are six large boilers, and great care has been exercised to provide a model installation in every respect, the work on the plant extending over a period of ten months. The engines were started at 4 P. M. on the 18th by ex-Judge Henry Hilton. The dynamos are placed on the Tenth street side of the immense building and are encased in glass from the customers' side of the house, thus permitting a free, unobstructed view of their operation.

The woes of electric railway companies are many, and occasionally their troubles take an amusing turn. This was the case when the Consolidated Traction company of Jersey City attempted to replace its horse car line on Johnson avenue and Pine street, Lafayette, with overhead electric construction. This account, given by the *Sun*, is worth repeating:

Expecting a protest of some kind, the company had its men working all Sunday night digging the holes for the trolley poles, and early Monday morning they started to set them up. One pole on the corner of Johnson and Pacific avenues had been successfully planted, and the men started to put up its companion on the other side of the street, when Henry Vrooman, acting on behalf of the Claprosses, who own a large part of the real estate in that district, planted a chair over the hole, sat down in it, and refused to budge.

The bystanders backed him up, and the men started to put in a pole a few feet away, leaving Vrooman sitting in his chair.

They had hardly started on this one before Miss Minnie Claproos, a determined lady of possibly thirty years, came up and ordered them to desist. The men laughed and went on with their work. After watching them a minute Miss Claproos turned around and jumped into the hole, exclaiming:

"Now, let's see you put that pole up here!"

The men stood back amazed, and the crowd of bystanders which had by this time gathered cheered enthusiastically. The hole was about four feet deep, and Miss Claproos is small and slender. Only her head, with its snapping black eyes, and the upper part of her shoulders could be seen above the pavement. As soon as the noise had subsided she turned her head around, and beckoning to a young lad, told him calmly to go and tell her brother that he must send some one to fill in the hole.

"And, mind now," she concluded, "don't you tell him what I've done."

This happened about one o'clock in the morning, and until nearly three o'clock in the afternoon the little woman's head was seen above the pavement, her eyes glaring defiantly at the company's workmen and her head nodding approval as she saw the other property owners and residents successfully putting a stop to the work.

When the man sent by Miss Claproos' brother arrived, the little lady was pulled out in triumph. Other residents were equally emphatic in their protests, and the company was finally obliged to make some concessions.

The State Board of Railroad Commissioners has dismissed the charges of H. M. Thompson against the Brooklyn City Railroad company, alleging that the financial reports had been doctored so as to deceive the stockholders. The board finds that the company's connection with the Long Island Traction company is in the interest of the stockholders, and that its accounts are all correct. Thompson is a stockholder in the Brooklyn company and is dissatisfied with the management of the corporation.

At a recent meeting of the Board of Electrical Control, when the application of the Special Fire Alarm Signal company for a franchise came up for consideration, the president of the company, Mr. Pierce, made the curious acknowledgment that the company had been doing business for twelve years without a franchise. The company recently discovered that even at this late day it would be a good thing to have one. No final action was taken on the application.

W. F. O.

## Milwaukee, Wis.

MILWAUKEE, December 21.—The efforts of Mr. Tillotson's Wisconsin Interurban Railway company to get the rest of the franchises needed in the Fox River valley towns continues to be the chief topic of interest among the electricians of the state. At Neenah the company has suffered defeat, and at Menasha action upon its application for a franchise has been deferred again. At a meeting held at Menasha the other evening a committee of citizens made a report to the common council in which it was stated that a franchise like that solicited by the Interurban company was already vested in the Menasha & Neenah Street Railway company and recommended that no other franchise be granted until the existing franchise was out of the way or until the Common Council was satisfied that no legal trouble would result from granting like rights to the Interurban company. The committee also reported that no company under the name of the Wisconsin Interurban Railway company had any legal existence. It also reported that it had found that Mr. Schumacher, the owner of the existing lines, had given an option on them at a very low figure to responsible men, the option to run until January 1st, and that if the option did not result in the sale of the road, Mr. Schumacher would sell the lines to any responsible bidder. The men who hold the option, according to the report of the committee, are Messrs. Elmore and others of Green Bay. Mr. Tillotson of the interurban project held the option at one time, the committee reported, and had forfeited it. The committee wound up its report by declaring that it was unanimously and unreservedly in favor of the interurban line, but recommended that the Common Council be not hasty in granting the franchise. A letter from A. L. Smith of Appleton was also read at the meeting. Mr. Smith started out by saying that it seemed to him that the granting of any franchise by Menasha to an outsider would be extremely hazardous at present. The sentiment of the people of the Fox River valley, he said, was largely in favor of the building of an interurban line from Neenah and Menasha to Kaukauna, but none of them wanted the line built by speculators, or the franchises put in the hands of speculators. The franchises should be controlled and owned by those who went into the enterprise as an investment. From representations that had been made it seemed that there were millions of money ready to take hold of the enterprise. Mr. Smith suggested that the council place the franchise in the hands of three trustees, to investigate the different propositions and report to the common council for its approval. After the attorney for Mr. Schumacher had stated that that gentleman had invested $18,000 cash in the present railway system and did not intend to see his rights taken away without a fight on his part, although he did not intend to block any legitimate enterprise so long as

he did not suffer, Editor T. B. Reid of Appleton got the floor and proceeded to explain Mr. Smith's letter. He said that Mr. Smith had arranged with eastern capitalists to absorb his Appleton street railway and to build the interurban line, and that the company stood ready to begin the work. Mr. Reid further said that the people and the Common Council were friendly to Mr. Smith and that no other company could get a franchise through that city. The speaker added that the company would put up bonds for $20,000 or for any other reasonable amount. President Pierson of the Appleton council endorsed what Mr. Reid had said. One gentleman stated that Mr. Tillotson was the first promoter of the road and that he ought to have the franchise if he could get financial backing; otherwise he would be shamefully treated. Mr. Reid explained that while Mr. Tillotson did not have any connection with Mr. Smith's enterprise, still he would be paid for his work, and that the Smith company would buy out Mr. Schumacher if it could get the opportunity. A vote was taken as to what the people of Menasha preferred, a road to Kaukauna or one to Oshkosh, in case both were out of the question, and the Kaukauna line got a big majority. The council adjourned until a week from next Tuesday without taking any definite action.

At the meeting of the Neenah Common Council the Tillotson franchise was killed without any ceremony. The members of the council who had investigated the matter were of the opinion that Tillotson and those whom he represented were not sincere in their dealings with Neenah and the ordinance was shelved. A proposition was presented by W. L. Davis and Thomas Higgins asking that a franchise similar to the one that Tillotson had sought be granted to them. If the franchise were granted to them, the applicants stated, the road would surely be completed and in operation by September 1, 1895, as they meant business. Their idea was to build a line from Oak Hill cemetery to Brighton Beach, independent of the street railway now in operation. It is thought that if the Neenah council grants any franchise Messrs. Davis and Higgins will get it. The matter is in the hands of a committee of three at present.

Tillotson has not given up the fight, however, and Oshkosh, the largest city along the route of the proposed interurban line, is still supporting him. He declares that the Wisconsin Interurban Street Railway company will be incorporated, and that it will build the line in Oshkosh without fail, and also the line from Oshkosh to Kaukauna if the franchises can be obtained. He announces that the following named gentlemen will serve as directors of his organization: George H. Ketcham of Toledo, O.; J. Kobusch, secretary, treasurer and general manager of the St. Louis Car company; Otto Van Schrader, secretary, treasurer and general manager of the Rankin & Fritsch Foundry & Machine company of St. Louis; Charles E. Loss of C. E. Loss & Co., contractors, Chicago; Worman McCarty of the Westinghouse Electric company of Toledo; F. M. Ohl, Toledo, and W. C. Gottshall, St. Louis.

Superintendent U. J. Fry of the telegraph department of the Chicago, Milwaukeee & St. Paul Railroad company and G. M. Basford, formerly engineer of signals on that road but now engaged in electrical appliance work in Chicago, have just patented a new railroad block signal system. It is claimed that the system makes collisions from the front or the rear impossible unless the enginemen flatly disobey the rules regarding signals. To let a train out of a block requires the work of two operators, from three to five miles apart, and in order to permit any accident both of them would have to make the same blunder at precisely the same time. The invention consists of a set of instruments connected with the rails and also with the semaphore at each block signal station. When the track is clear as far as the next station, the train is allowed to pass into that block, and the semaphore at the station which the train leaves is locked so that the operator at that station cannot open it if he desires to. When the train arrives at the other end of the block the operator at that station unlocks the semaphore at the first station by pressing a button on his desk, which notifies the operator at the first station that the train has passed out of the block. By a train's entering the block the signal system is placed in an abnormal condition, and when the train leaves the block, it automatically places the system in its normal condition by contact with the electrical device on the track. A train following would be locked out of the block by the operation of the track system as well as by the operators. The system, it is claimed, applies equally as well to single track roads, preventing a train going east from entering the block so long as there is in the block a train going either east or west.

There is pending in the common council of Oconomowoc a franchise for a street railway system to be operated by horse, electricity or other power.

The Milwaukee Board of Public Works has decided to operate the folding draw of the new Sixteenth street viaduct by electricity. The current will be supplied from the National avenue street car line. The city will have to pay for the power, because the bridge is not one over which cars are run.

The contract for the complete construction and equipment of the Waukesha Beach railway has been awarded to C. E. Loss & Co. The rolling stock has not yet been ordered.

Before the engineering students at the Wisconsin State University at Madison, Louis A. Ferguson, electrical engineer of the Chicago Edison company, recently delivered the first of a series of lectures by outsiders on electrical subjects. His subject was "Modern Electrical Power Stations." C.

## PERSONAL.

H. T. Richards, of the *Electrical Review* of New York, has resigned to accept a responsible position with the Fidelity & Casualty company of New York. Mr. Richards is an experienced advertising man and in his five years' connection with the *Review* he made a large number of friends, who will join the WESTERN ELECTRICIAN in sincerely wishing him success in his new venture.

## NEW INCORPORATIONS.

Findlay Telephone company, Findlay, O.; capital stock, $15,000.

Ferris Electric & Manufacturing company, Cedar Rapids, Iowa; capital stock, $10,000.

People's Electric Railway company, Terre Haute, Ind.; capital stock, $100,000; to operate an electric railway; A. J. Crawford, Terre Haute, Ind.

American Telephone Construction company, Anderson, Ind ; capital stock, $200,000; to construct and operate telephone plants at Noblesville, Lebanon, Bluffton, Laporte and Anderson; Charles M. Harriman, Anderson, Ind.

Sidney Electric Railway company, Sidney, O.; capital stock, $100,000; to operate a line of electric railway in and through the village of Sidney, thence to the village of Loramies, thence to the village of Minster, O., for the carrying of passengers, baggage, mail, freight and express.

## ELECTRIC LIGHTING.

The electric plant in Osawatomie, Kas., was burned on December 11th, entailing a loss of $8,000.

The Edison plant in Oskaloosa, Ia., was destroyed by fire on December 12th. The loss is estimated at from $10,000 to $12,000, partially covered by insurance.

The Dayton, O., Electric Light company is said to have passed out of the control of the General Electric company. The stock is now owned almost entirely in Dayton.

Electric light was introduced in Grand Island, Neb., on December 1st, the company starting with 500 lamps. It is claimed that this number has been increased to 1,000 lights. There is a lively competition between the electric and gas companies.

The application of the city solicitor of Middletown, O., to enjoin the city council from entering into a contract with the Middletown Electric Light & Power company for the lighting of the streets of Middletown for the next ten years was denied by Judge Giffen at Hamilton. The city solicitor sought to set aside the contract on the ground that it had not been let to the lowest bidder; that the election was illegal for the reason that it should have been held at the spring election, as the statutes provided for the holding of such elections at the regular election of the municipality. The court overruled every point made by the solicitor, deciding that the word "regular" in the statutes did not mean the spring election, but any election where the people were called upon to vote on questions of general public interest. The solicitor has given notice of appeal.

An ordinance has been introduced in the Chicago city council granting a franchise to the Citizens' Light & Power company to lay electric wires for a term of twenty-five years in or under the streets, alleys and sidewalks by and with the consent of the adjacent property owners in the down-town business district bounded as follows: On the north by Jackson street, on the east by Lake Michigan, on the south by Taylor street and on the west the south branch of the Chicago river. The franchise grants power to lay, operate and maintain within the territory named a line or lines of electrical conductors for the purpose of furnishing light, heat and power. The ordinance provides that the work shall be done under the direction of the commissioners of public works; that no work shall be done except between the hours of 7 P. M. and 7 A. M., the work to begin at once, and all streets, alleys or sidewalks torn up shall be restored, the company giving sufficient bond for this purpose before the permit is issued. The ordinance also provides that the company shall deposit a bond of $25,000 with the comptroller and shall also pay to the city yearly 3 per cent. of the gross receipts of the company.

## ELECTRIC RAILWAYS.

C. E. Loss & Co. will build the electric railway from Alexandria to Marion, Ind., for $525,000. This firm also built the road from Broad Ripple to Indianapolis, and has the contract for the Indianapolis and Franklin road.

The six miles of the Castle Shannon narrow-gauge railroad, near Pittsburg, will be changed to standard gauge and electricity substituted for steam as motive power. If the plan is successful the number of stations on the line will be doubled.

The Traction company of Baltimore expects to have its Gilmor street line equipped with electricity by January 15th. The line is now operated by cable. Contracts for the overhead work have been awarded and the electric cars have been built and are on their way to Baltimore.

The Laurie Engine company, Montreal, has built for the Toronto Street Railway company the largest engine ever manufactured in Canada for a similar purpose. Its normal capacity is 1,200 horse power, and its generative power from 1,500 to 2,200 amperes. It cost over $50,000. The fly-wheel weighs 80,000 pounds, is twenty feet in diameter, and is built directly on the shaft and put up in ten sections. The combined weight of the fly-wheel, armature, shaft and generator is upward of 70 tons.

Work will shortly be begun on the Baltimore-Washington Boulevard company's electric line. It is understood that contracts have been let for the line between Washington and Laurel, a distance of 17 miles. It is expected that cars on the line will reach a rate of speed of a mile a minute, but the scheduled time will be about one hour between the two cities. David Newbold, president of the company, is in Philadelphia completing arrangements for the work. The road will reach Baltimore by way of Catonsville.

By paying into the treasury of the town of Cicero, Cook county, Ill., $25,000 within thirty days and giving a bond for the same sum to insure completion of the road within two years, the Ogden Street Railroad company has obtained the right to operate electric railways in the southern part of the town. The overhead trolley system will be used. The fares will be five cents for a continuous trip and transfers will be given to the Cicero & Proviso street railroad. The company will invest $1,000,000 in tracks and rolling stock.

The Detroit Railway company, which proposes to make a 3½ cent fare rate, has been incorporated with a capital stock of $1,000,000. One-half of the stock is taken by the Packs and Everett, and $100,000 of this stock has been paid in. The remainder will be paid in when called for. It cost the company $500 in a state tax to incorporate. When and to whom the remaining half of the stock will be issued is not decided. The directors of the new company were elected as follows: Green Pack, Albert Pack, H. A. Everett, C. L. Pack and C. W. Wason.

The building of the electric road on West Monroe street, Chicago, is progressing at an astonishingly rapid rate. There is something mysterious about the work. The company is prevented by its franchise from using the overhead wires; it is not being built for an underground conduit system; its owners will not tell just what system is to be used. Possibly some form of storage battery is to be used to provide motive power, but it is more likely that the overhead system will be eventually employed. This new road is being built by the Chicago & Jefferson Urban Transit company. It may be controlled by Mr. Yerkes, or it may not. That is another bit of mystery. Anyhow, the road is being built and built rapidly—from Canal street out Monroe to Morgan, then north on Morgan to Fulton. That is to be the present western terminus.

## MISCELLANEOUS.

Negotiations are in progress by the management of the Cotton States and International Exposition at Atlanta for an electric fountain of very much the same character as that which was in operation at the World's Fair. This feature in the center of the open area will be one of the most attractive, and will draw thousands of people at night.

The South Yuba Water company has applied for a franchise to bring in electric energy for power, light and heat into Sacramento, Cal. The power site is at Newcastle, thirty miles distant, and the company proposes to supply Auburn, Newcastle, Penryn and Rocklin with electricity. The company claims to be able to furnish 4,500 horse power for Sacramento.

An idea of the part electricity plays in the development of cities may be gained by comparison of the statistics which have just been gathered by Prof. Gilmore for the article upon Rochester in Johnson's Encyclopædia with the article written ten years ago by Fred. A. Whittlesey. The population in 1880 was 89,360; in 1890, 133,896, and in 1894 152,000. In the last ten years the increase has been over 50,000. Three gas companies with a total capital of $1,800,000 and with 90 miles of mains supplied the city with unsatisfactory gas light ten years ago. The gas and electric company with a capital of $4,300,000 furnishes the far better gas and electric light that is now Rochester's. A street railway company operated 40 miles of track in 1880 and offered for the accommodation of passengers the bobtailed horse cars that moved little faster than one would walk and in the bottom of which was loose straw in winter to keep the feet from freezing. How different the facilities offered to-day! There are 85 miles of trackage, over which the rapid and comfortable electric cars carry its passengers in less than one-half of the time. The transfer system is also an innovation.

## TRADE NEWS.

S. Victor D'Unger, formerly of the electrical firm of D'Unger Bros. of Baltimore, is now connected with Taylor, Dee & Mack of 320 Dearborn street.

The Fontaine Crossing & Electrical company, Detroit, Mich., has appointed F. P. Thorp its Chicago agent, with offices in the Rookery. Mr. Thorp recently established himself as designer of electrical and mechanical apparatus for complete electric light and power plants. He is well known to the electrical fraternity, having been connected with the Brush Electric company, the Detroit Electrical Works, the World's Columbian Exposition, and the Siemens & Halske company.

The foreign business of the R. D. Nuttall company of Allegheny City, Pa., is growing considerably of late. The company has shipped an order of "improved trolleys" to Paris, France, to be used on an electric street railroad, and

it is now about to fill a similar order for a street railway company in Belgium.

The Lancaster Railway Construction company has secured the contracts for building the extensions of the Reading Traction company's system at Reading, Pa. The first line will be fifteen miles in length and work will be commenced at once. Everything will be up to the highest standard and the Medbery line material will be used on the overhead line work. All material will be furnished by the Hubley Manufacturing company.

## BUSINESS.

A very interesting catalogue of some up-to date electrical specialties is being mailed by the Washington Electric company, Chicago. Anyone wishing to secure a copy can do so by sending a postal card to the company.

The Berlin Iron Bridge company of East Berlin, Conn., has just completed a new boiler house for the Metropolitan Electric company at Reading, Penn. The roof of the Clinton, Mass., Wire Cloth company's new boiler house is of iron, and is covered with the Berlin company's anti-condensation corrugated iron.

For ten years the desk calendar issued by the Pope Manufacturing company, Hartford, Conn., has held a unique place among business helpers. The calendar for 1895, which is just issued, is even brighter than its predecessors in appearance, as clever artists have added dainty silhouette and sketch to the usual contributions that have heretofore given this popular calendar its charm.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued December 18, 1894.*

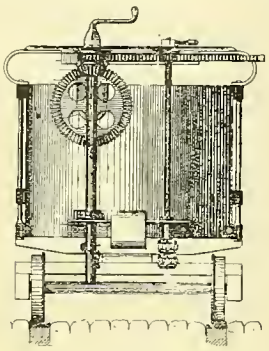
530,951. Electric Conduit. Thomas T. La Pointe, James H. Flanagan and Charles A. Thompson, New Haven, Conn. Application filed November 23, 1893.

A conduit for electric light wires, consisting of separate sections, each of which has a peripheral casing, heads thereon provided with joint rings and a grout composition in the casing perforated with passages extending from the fillings in one head-plate to the fillings in the other head-plate, is described.

530,954. Trolley Wire Finder. Frederick F. Meyer and William S. Meyer, Newark, N. J. Application filed March 14, 1894.

In this trolley device there is the combination of the trolley pole and wheel, with a trolley wire finder pivotally connected with the trolley pole, consisting essentially of pivoted finder arms extending laterally back of the trolley wheel, a ring having a loop connected with the finder arms, and means connected with the ring and its loop for bringing the finder arms in position on opposite sides of the trolley wire.

530,956. Hand Operating Mechanism for Electric Locomotives. Andrew W. Mitchell, Boston, Mass. Application filed April 14, 1892.



NO. 530,956.

The second claim for the invention herewith illustrated follows: In an electric car, in combination, a rod connected to the brake mechanism for braking the car, a gear secured thereto, a miter gear secured thereto, a miter gear turning in a suitable support and engaging with the brake rod miter gear, a lug or ear piece on the separate miter gear, a rack bar arranged to slide back and forth in a suitable support and engage with the gear on said rod, a lug or ear piece on said rack bar arranged to engage with the lug or ear piece of the miter gear, a rod turning in suitable bearings arranged and adapted to be connected to the rheostat or electric controller of the electric motor and a gear secured to said latter rod engaging with the rack bar.

530,957. Finger Board Telegraph Key. Elmer E. Mullnix, Burlington, Kas. Application filed July 31, 1894.

A series of independently revolnble telegraphing wheels provided with peripheral symbol projections, and a single continuous movable press rod normally held in contact with the peripheries of all of the wheels and arranged to work over and onto a separate telegraph or circuit closing key.

530,975. Circuit Closer for Burglar Alarm Systems. Alfred Stromberg, Chicago, Ill. Application filed May 24, 1894.

A plate connected in a protective circuit, a plunger adapted to make contact with the plate and to be depressed when the covering is closed, contact springs adapted to be engaged by the plunger in the depressed position thereof, a resistance connected between the springs and ground, a local circuit at the central office containing a battery and a signal device, an electro-magnet thereat adapted to close the local circuit when the protective circuit is opened, and an electro-magnet adapted to close the local circuit when the resistance is cut from the circuit.

530,976. Burglar Alarm System. Alfred Stromberg, Chicago, Ill. Application filed May 24, 1894.

The first claim is given: The combination with a removable covering for an opening, of a socket provided with contacts, a removable plug provided with contacts adapted when the plug is inserted in the socket to engage the contacts of said socket to complete a protective circuit, said socket being so located that the plug, when inserted therein, will lie in the path of said removable covering to prevent the uncovering of the opening without the removal of the plug, and signal apparatus in circuit with said plug adapted to sound an alarm when the plug is withdrawn from the socket.

531,002. Electric Program Clock. John L. McCaskey, Waynesborough, Pa., assignor to Frederick Frick. Application filed September 13, 1893.

The principal features of this invention are: A calendar switch, the ratchet of which is provided with a single movable contact and a series of conducting plates in the path of the contact and insulated from each other, and having suitable electrical connections and means controlled by the clock for rotating the spindle of the calendar switch.

531,005. Electric Converter. Frank C. Priestly, San Francisco, Cal. Application filed February 16, 1894.

In the electric converter described there is a core composed of two segments formed by superposed sheets of thin metal fastened together, the sheets of each segment having a series of extensions or projections extending between corresponding extensions or projections on the opposing segment, and the ends of the projections on each sheet are beveled or inclined in the same direction, with means for forcing the segments together.

531,018. Sign Advertising Machine. Orlando P. Briggs and William R. Patterson, Chicago, Ill. Application filed January 26, 1894.

This invention is a form of the device now quite generally employed for forming words or characters with electric lamps successively illuminated, and an automatically operated pointer which traces the words or characters as the lamps are lighted and extinguished.

531,070. Controlling Device for Elevators. Alonzo B. See and Walter L. Tyler, Brooklyn, N. Y. Application filed August 24, 1894.

An electric elevator is provided with a stationary shunt-wound motor, a magnetically controlled reversing switch and circuit closer at or near the motor, a resistance in the armature circuit, a regulator for gradually cutting it out, a regulator for gradually varying the resistance of the field magnet circuit, and a controller mounted on the car provided with contacts for controlling the reversing switch, the circuit closer and the field magnet resistance.

531,077. Coupler for Organs. Charles Wales, Detroit, Mich. Application filed February 10, 1894.

In this instrument there are a series of pipe actuating devices and an electric circuit arranged in multiple, contacts in the circuit, a switch engaging the contacts, a key for actuating the switch, and means for engaging and moving the contacts out of operative relation with the switch.

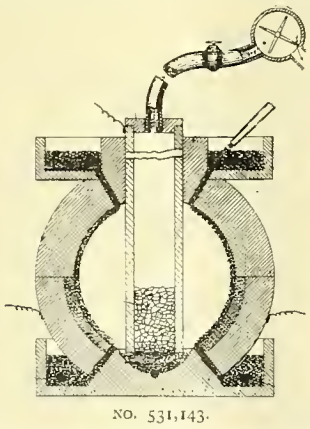
531,078. Telephone Speaking Tube System. Thomas C. Wales, Jr., Boston, Mass. Application filed April 7, 1894.

This is a telephone speaking-tube system comprising a plurality of stations. There is a plurality of circuits, a common source of electricity, and a call wire, the circuits extending to each station and provided with normally open branch terminal switches or spring-jacks, one for each circuit the inner springs of which are connected to the respective conductors of the home circuit, and the outer springs are connected to the respective conductors of the associated circuits, with a plug connector, and telephones in a normally open bridge of the home circuit, and branches from the circuit conductors to the source of electricity, one of each pair having included therein an electro-magnetic resistance. Upon the insertion of the plug connector into a spring-jack, and the removal of the telephone from the hook switch, the home circuit is linked to a distant station, and the telephones are automatically bridged into the circuit.

531,130. Electrical Switch Setting and Locking Device. Karl Moleregger, Vienna. Austria-Hungary. Application filed February 8, 1893.

The invention is described as the combination with a railway switch, comprising switch rails, a screw shaft, a nut adapted to travel along the screw, and connections between the switch rails and nut, of an electro-motor coupled to the screw shaft for rotating it, and electric switch devices coupled with the motor and the switch rail actuating mechanism, whereby as the switch is set over in one direction by operation of the mechanism, the contacts will be automatically readjusted in readiness to reverse rotation of the screw shaft on the next passage of the current through the motor.

531,143. Apparatus for Electric Heating, Smelting and Separating. Joseph W. Woodfolk and John C. Wharton, Nashville, Tenn. Application filed December 12, 1893.



NO. 531,143.

The device, as shown in the above cut, is an electric heating and smelting apparatus, having means for circulating a body of water, and the chief features are the hollow electrode through which the material to be treated is fed, the electrode surrounding the hollow electrode and through which the water circulates, and the connections from an electric source to the electrodes.

531,146. Signal Lamp for Electric Railway Cars. Charles H. Baker, Detroit, Mich. Application filed April 24, 1894.

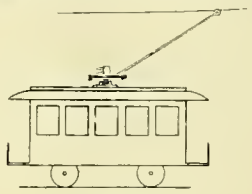
The illustration shows a trolley support of an electric railway car, an electric signal lamp inclosed in the casing secured to the rotary support of the trolley arm, and having one terminal of the lamp in electrical contact, an arm secured to the lamp casing constituting the other terminal of the lamp, and a fixed contact ring with which the arm is adapted to form a traveling electric contact, the contact ring forming one terminal of the lamp circuit on the car.

531,153. Electric Meter. Theodor Bruger, Bockenheim, near Frankfort-on-the-Main, Germany. Application filed June 22, 1894.

Claim 1 follows: In alternating current meters, the combination of a shunt electro-magnet arranged in parallel circuit with the lamps, an armature arranged between and in line with the pole ends of said shunt electro-magnet, a rotary metallic cylinder inclosing the armature, and a main electro-magnet within whose field the cylinder and its inclosed armature are located, said field intersecting the field of the shunt magnet, and said main electro-magnet being arranged at such a distance from the armature that the phase movement between the two fields is as great as possible, the interval of proportionality between the current and velocity being within broad limits, and the damping by Foucault current rendered very effective and independent of the main current.

531,194. Telephone Transmitter. David A. Kusel, St. Louis, Mo. Application filed August 6, 1894.

Here is the claim: The combination of the diaphragm holder, having opposite perforated ears projecting a distance beyond its rear edge, clamping screws extending in alignment and threaded into said ears, with their headed ends outward, an internal annular flange or shoulder on said holder, to support the diaphragm some distance in the rear of the front piece of the transmitter box a diaphragm, a clamping ring loosely mounted in rear of said diaphragm and provided with diametrically opposite projections, having inwardly and rearwardly converging or inclined surfaces, which are engaged by the inner ends of said clamping screws, whereby when said screws are moved toward each other they will forcibly engage said inclined surface of said ring and urge the latter forward into intimate contact with said diaphragm, an electrode adjacent said diaphragm, and suitable connections



NO. 531,146.

531,214. Electric Safety Appliance for Railroads. Elward L. Orcutt, Somerville, Mass. Application filed November 2, 1893.

A track circuit formed in part of the rails of the track, and a parallel or actuating circuit so arranged that the charging or breaking of one circuit will close or break the other, and a contact plate in each circuit, a source of electricity, a closed track circuit charging circuit, a closed parallel or actuating circuit charging circuit, and a closed train-controlling circuit on the train switching or looping brush in the track circuit charging circuit, and in the parallel or actuating circuit charging circuit to engage respectively the contact plates in the track circuit and parallel or actuating circuit to loop the latter circuits into the former when the brushes engage the plates, and mechanism operated by the breaking of either circuit to stop the train.

531,268. Brake and Power Controller for Electric Cars. Andrew W. Mitchell, Boston, Mass. Application filed January 22, 1894.

A brake rod of a car, having a handle or wheel, a gear on its lower end, a rack bar arranged to slide back and forth in suitable guideways to engage with the gear, another gear on a suitable support arranged to engage with the rack bar, a sprocket wheel connected to the latter gear or its journal, and a chain engaging with the sprocket wheel and with the rheostat or electric controller of an electric motor.

531,275. Street Car Motor. John Radomski, Baltimore, Md. Application filed July 13, 1894.

The combination comprises two track rails, rollers on the roadbed between the two track rails arranged in two longitudinal lines and spaced apart, a car provided with flanged wheels to traverse the track rails, a transverse bar underneath the car, and a pressure frame below the car axles, and having one end hinged to the transverse bar and the other end free to be raised or lowered.

531,284. Electric Block Signaling System. Adoniram J. Wilson, Port Chester, N. Y. Application filed May 14, 1894.

A track block is divided into subsections, a track circuit being provided for each subsection, a normally de-energized signal circuit for the block, means for energizing the signal circuit in the rear of the block, and means for de-energizing the signal circuit upon a change in the electric condition of each of the track circuits of the block, two or more of the track circuits being so connected together that when one of them is operated another is also operated to affect the signal circuit, a switch for the block, and an indicator therefor, a circuit for operating or controlling the indicator, and means for operating the indicator circuit located in the rear of the indicator.

531,288. Incandescent Electric Lamp Socket. Charles H. Balsley, Connellsville, Pa. Application filed April 20, 1894.

In this electric lamp socket the body is provided with a transverse septum a lamp clamp, a conductive part, make-and-break mechanism between the lamp clamp and conductive part, a lamp head connecting part projecting through the septum in electrical connection with the conductive part, a cap adapted to be secured to the body and provided with line wire connections, and conductive plates in electrical connection with the line wire connection, and adapted when the cap is secured to the body to be in contact with the conductive parts therein.

531,291. Guide for Trolley Wheels. William H. Dickerhoof, Cincinnati, O. Application filed July 23, 1894.

A trolley is described having its axis mounted on bearings and capable of a vibratory movement thereon independent of the movement of the bearings, guide arms connected with the axis and pivoted to the bearings, and a yielding connection between the guide arms and the bearing supports.

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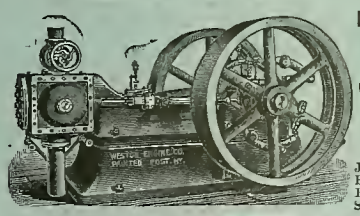

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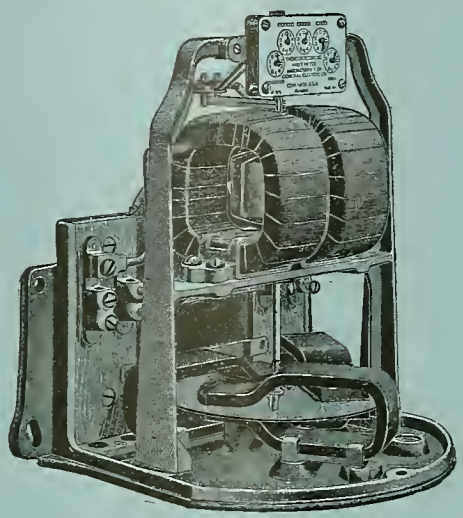

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Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
Hill, W. S. Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Rafferty & Co., T. C.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons, Points & Plates.**
Central Electric Co.
General Electric Co.
Metropolitan Elecrict Co.
Partridge Carbon Co.
Western Electric Co.

**Car-Heaters, Electric.**
Consolidated Car-Heating Co.

**Clutches, Friction.**
Lake, J. H. & D. Co.

**Conduits.**
Fibre Conduit Co., Tbe.

**Construction & Repairs.**
Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Hartley Elec. Wks.
Johnson, Montgomery H.
Osburn, Harry G.
Stone, O. M.
Washington Electric Co.
Wirt, Chas.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, H. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
La Roche Electric Wks.
Mather Electric Co.
Monrath, Gustave.
Osburn, Harry G.
Roberts & Co., E. P.
Siemens & Halske Elec. Co.
Stone, O. M.
United Elec Improvement Co
Westingbonse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Mismisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
General Eectric Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Rafferty & Co., T. C.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Electric Appliance Co.
Hubley Mfg. Co.
Metropolitan Electric Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Hubley Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Perkins Elec. Switch Mfg. Co.
Sioux City Brass Works.
Wallace Electric Co.
Western Elec. Supply Co.

**Desk Lights.**
Cooke, E. D.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg Co.
Elbridge Elec. Mfg. Co.
General Electric Co.
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
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Rose Elec. Light Supply Co.
Roth & Eck.
Royal Electric Co.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Electric Railways.**
Brush Electric Co.
General Electric Co.
Hubley Mfg. Co.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Hall, Wm. D.
Bryan, Wm. H.
Cameron & Gillett.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Johnson, Montgomery H.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Rae, Frank B.
Roberts & Co., E. P.
Stone, O. M.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Metropolitan Electric Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
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Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

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Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

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Colburn Electric Mfg. Co.
General Electric Co.

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Ball & Wood Co., The.
Ball Engine Co.
Brownell & Co., The.
Freeman Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Weston Engine Co.

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Morse, Williams & Co.

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Bolgiano Mfg. Co.
Central Electric Co.
Cbi. Water Motor & Fan Co.
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Diehl & Co.
Roth & Eck.

**Fibre**
American Hard Fibre Co.
Butler Bard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

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Butler Hard Rubber Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Elsctric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.

**Gears.**
Grant, Geo. B.

**General Elec. Supplies.**
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Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cooke, E. D.
Crescent Electric Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Caoot Electric Co.
Hubley Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Palmer Bros.
Rafferty & Co., T. C.
Sioux City Brass Works.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

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Hemingray Glass Co.
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Hubley Mfg. Co.

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Bernard Co., The E. G.
Bunnell & Co., J. H.
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Chicago Gen'l Fixture Co.
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Empire China Works.
Fibre Conduit Co., The.
Hammond Cleat & Ins. Co.
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Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
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Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
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**Insulated Wires and Cables—Magnet Wire.**
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Bunnell & Co., J. H.
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Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Hubley Mfg. Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Rafferty & Co., T. C.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
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**Lamp Shades.**
Cooke, E. D.

**Lamps, Incandescent.**
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Beacon Vac Pump & Elec.Co.
Bernstein Electric Co.
Buckeye Electric Co.
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Royal Arc Electric Co.
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Wirt, Chas.

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(See Insulated Wires.)

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Worthington, Henry R.

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Consolidated Car-Heating Co.

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Central Electric Co.
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Cushing & Morse.
Chicago Ins. Wire Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S
Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

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National India Rubber Co.
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CHICAGO, 1137-1138 Monadnock.

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BOSTON, 75-81 Cornhill.

**Manufacturers of High Grade Wires and Cables.**

Simplex T. Z. R. Weatherproof Wires.
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Simplex Mining Wires.
Simplex Lead Covered Cables.
Simplex Submarine Armored Cables.

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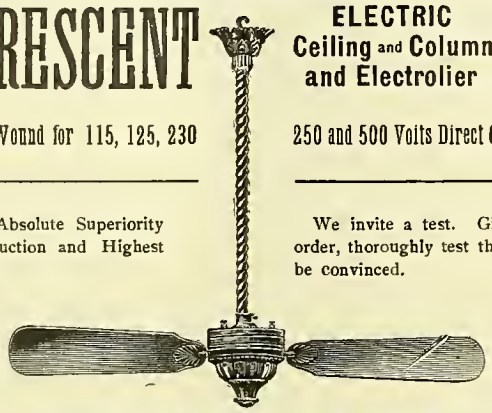
THE CRESCENT ELECTRIC Ceiling and Column and Electrolier FANS

Are Wound for 115, 125, 230 250 and 500 Volts Direct Current.

We claim Absolute Superiority of Construction and Highest Efficiency.

We invite a test. Give us a sample order, thoroughly test the Crescent, and be convinced.



**THE CRESCENT ELECTRIC CO.,**

Manufacturers of Electrical Specialties,

AGENTS WANTED. Lancaster, Pa.

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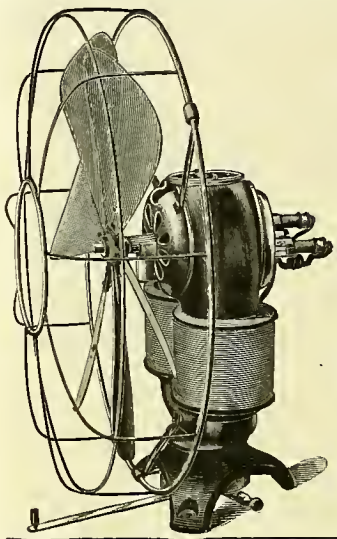

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Perfect in Design,
Durable, Economical,
Noiseless, Self-Oiling.

Finely Finished in Rich Black Japanning with Nickel Plated Trimmings.

Our Prices Will Defy Competition.

Send for Circular and Price List to

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MANUFACTURERS OF

*Dynamos and Motors,*

32 Market Street, CHICAGO.

AGENTS WANTED.

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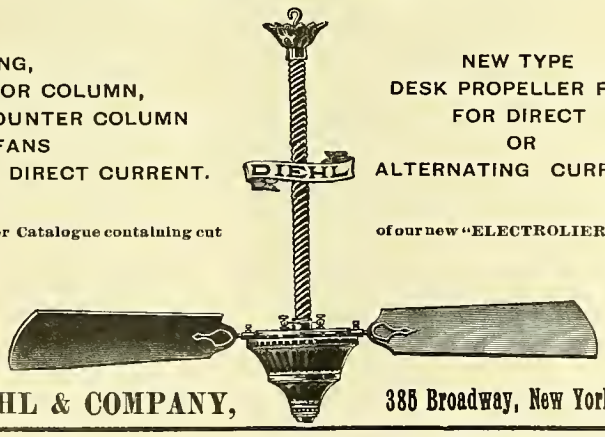
# THE DIEHL ELECTRIC FANS.

NO BELTS. NO SHAFTING.

CEILING, FLOOR COLUMN, COUNTER COLUMN FANS FOR DIRECT CURRENT.

NEW TYPE DESK PROPELLER FANS FOR DIRECT OR ALTERNATING CURRENT.

Send for Catalogue containing cut of our new "ELECTROLIER" FAN.




DIEHL & COMPANY, 385 Broadway, New York City.

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# The Harrison International Telephone Co.

AGENTS' TERRITORIES NOW BEING ALLOTTED.

WRITE AT ONCE.

WHAT MONEY CAN EARN AND THE PEOPLE SAVE BY MEANS OF THE

Harrison International Telephone.

**We either sell our telephones outright or lease them for a term of years.**

This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Patent No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete electric speaking telephone operated by battery; and owns Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

Prospectuses furnished by addressing the Company at their offices,

**44 and 46 Wall St., New York.**

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1821. **MORRIS, TASKER & CO.,** 1888.

INCORPORATED.

Offices, 222-224 S. Third St., Philadelphia, Pa.

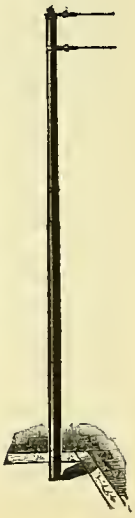
PASCAL IRON WORKS, PHILADELPHIA.

DELAWARE IRON WORKS, NEW CASTLE, DEL.

Manufacturers of

## Boiler Tubes, Wrought Iron Pipes and Fittings.

ELECTRIC LIGHT and RAILWAY PIPE POLES A SPECIALTY.



Okonite Wire.

Interior Conduit Supplies.

Helios Arc Lamps.

Washington Carbons.

# No Solution Yet.

### The Electrician's Wooing.

My darling, wire you so cold?
Prey let my ohm be thine;
This system me a joy to hold
And pressure hand in mine.

Though you may search from pole to pole,
You'll find that I ampere
Of anyone, so let us join,
No motor part, my dear.

The gold our station will demand,
Our needs to gratify,
The circumstances I am in
Can descently supply.

The current of my thought is toward
One central lamp of bliss,
One heart I volt of there to cling
Need dynamo's it is?

So let us haste to lay our views
Before your pa and ma,
But if they their consent refuse,
Let's skip the trolley-is.

Of all the replies, good, bad and worse, that came floating to us through the sizzling summer air, not one seemed to approach a rational solution of the lines. We really thought better of our friends; however, the efforts were commendable, and we've had no end of fun over it. Rather the best thing that came to hand was the one published below.

It is from the wilds of Manhattan Island, and is fraught with a scintillant meter that entitles the author to rank along with Jim Riley, Ben King, Bill Nye and the Atlanta Constitution paragrapher.

### The Maiden's Reply.

The maiden read with glad surprise
The lines above, as quoted,
And telephoned the gentleman
Below, as will be noted.

"Unit my heart to yours, dear sir,
I offer no resistance,
And come watt will, I'm yours from date,
That is, with some assistance.

There's bare and bolts between us, dear,
For pa's opposed to sparking,
And keeps a dog to scare away
All gentlemen, by barking.

My ohms surrounded by a wall
That's made of brick and clay, sir;
I ne'er could climb it e'en for you,
For I'm not built that way, sir;

But could you get a pole somewhere
(Long double poles are better),
And place them both against the wall,
Advising me by letter?

Why then, I'd ready be for you;
On top the wall we'd meet, dear,
And gently sliding down the poles
We'd land upon our feet, dear.

And once outside this horrid wall
Which keeps us now asunder,
We'd laugh at bars and McKinlocks,
And married be—by thunder."

# Extract from a Paris Letter.

* * * * * *

This is the type of a man that the weather never wrinkles. He is as impregnable to the scorching rays of a July sun as he is to the importunities of his foreign son-in-law. He is quite an aggravating atom in the social fabric, he is so cool while every other body is fairly roasting.

No not **every** body—some of the smart set have provided themselves with one of those delightful American inventions, a fan-motor. Next to an egg-nog, also an American invention, I think they are deserving of unusual favor; doubtless Mr. Lundell, the inventor, will be elected one of the Society of Immortals. I have seen these fan-motors in all the swell resorts and cafés, and they are simply ubiquitous on the avenue des Arcadias in the Bois.

You will naturally want to know where they can be purchased. I think a Chicago firm, The Central Electric Co., have them for sale in America.

This evening I am going to lunch with a delightful little creature at the Café Chinois, and afterward we will take a spin on a bicycle.

* * * * * *

This melting heat ought to be sufficient argument in favor of Fan-Motors—we've got every imaginable kind to suit you and your customer—don't disappoint him by putting up an inferior kind. The **best** is Lundell's.

Our stock of construction material, tools and supplies was never more complete than now—our catalogue is an epitome of the higher grades of electrical merchandise. If not already in possession, get one.

**SPECIAL AGENTS:**
**Gate City Electric Co., Kansas City, Mo.**
**Southern Electrical Supply Co., St. Louis.**

**The Central Electric Company,**
173-175 Adams Street,
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# HUBLEY
## MANUFACTURING COMPANY.

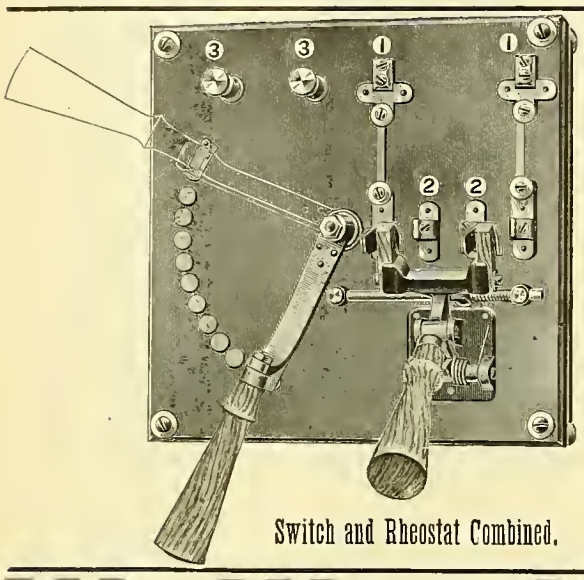
**TROLLEY WHEELS,** Bronze, Brass or Iron, patent graphite bearings, a ***10,000 mile record***—Still running.
**TROLLEY HARPS,** Brass, Bronze, Malleable Iron or Steel. Light, strong, new design. Cheapest and best on the market.
**BEARINGS** For Dynamos and Motors. We guarantee 20 per cent. more life than any anti-friction metal offered for sale.

**Line Ears, Splicing Ears, Curve Pull-Offs, Single and Double Connectors.**

## ELECTRIC LIGHT SUPPLIES.

Switches, Cut-Outs, Regulating Sockets, all of our design and patents. Bare, Weatherproof and Magnet Wire, Arc Light Globes, Pins, Cross Arms, Black and White Tape. Complete equipment for Electric Lighting Plants. Estimates furnished for Electric Railway Installations.

**SAVE MONEY.**
**ASK FOR NEW CATALOGUE** **HUBLEY MANUFACTURING COMPANY, Lancaster, Pa.**



Switch and Rheostat Combined.

## PROTECT YOUR MOTORS
BY USING THE
## Hill Patent Self-Locking Starting Switch.

**No possible chance for an accident, as the Switch cannot be closed until the resistance is all in.**

**CHEAP. COMPACT. DURABLE.**

Made only by the
## W. S. Hill Electric Company,
133 Oliver Street, BOSTON, MASS.

SEND FOR CIRCULAR AND PRICE LIST.

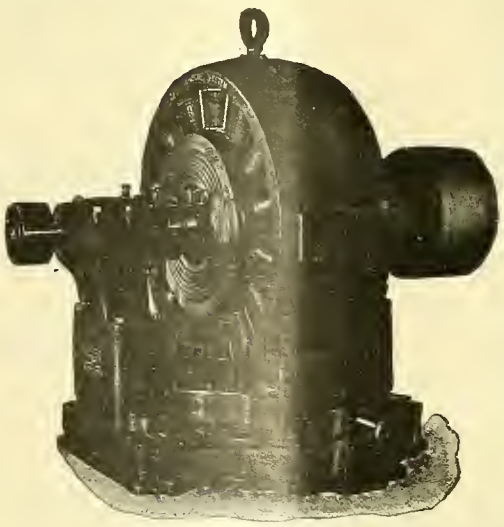
NEW YORK, ELSON & BREWSTER, 143 Liberty Street. CHICAGO, CENTRAL ELECTRIC CO.

# We Want Western Business.

# LA ROCHE ALTERNATORS.

MANUFACTURED IN SIZES FROM
*25 to 5,000 Lights,*
SINGLE OR MULTIPHASE.

Direct Connected Dynamos.
Direct Current Generators.


1,000 Light Alternator.

## La Roche Electric
WORKS,
PHILADELPHIA, PA.

DISTRICT OFFICES:

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| New York, | | San Francisco, |
| Boston, | | Chicago, |
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CHICAGO.

**OWEN FORD, Rialto Building,**
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# BARGAINS.

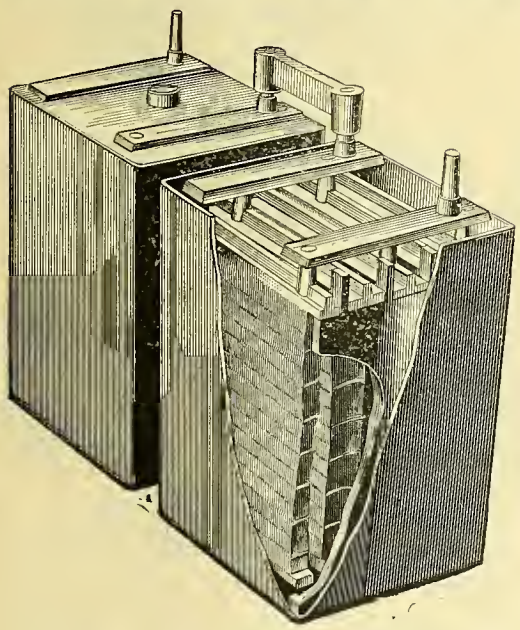
Having purchased the remaining stock of the Ansonia Electric Company's Chicago branch, and removed same to our store, we are enabled to offer a large amount of standard electrical material at prices below the actual cost of manufacture, including railway glass insulators, porcelain insulators, cross arms, Fletcher's sleet proof pulleys, high insulation brackets and windlasses, fuse links and wire, carbon brushes and sheets, glass and porcelain shades, Cleveland arc cut-outs and switches, moisture-proof sockets, carbon cases, battery coppers, 6x8, etc., etc.

**Our regular line includes all Electric Railway Supplies, Insulated Wire, Electrical Material, Incandescent Light Supplies, Electrical House Goods.**

**Write for Prices.**

**WALLACE ELECTRIC COMPANY,** 307 Dearborn Street, CHICAGO.

# STORAGE BATTERIES.



## Electric-Power Storage Company,

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**STANDARD PLANTÉ STORAGE BATTERIES.**

These batteries will not polarize or sulphate, and their plates will not disintegrate and cannot buckle. Highest efficiency, Largest delivery, Lowest internal resistance. Can furnish cells from ten to ten thousand ampere hours' capacity. Batteries for central station work, batteries for electric launches, for surgical, dental and medical work, and for all purposes to which storage batteries are applicable. All cells tested and guaranteed. Complete lighting and power plants installed.

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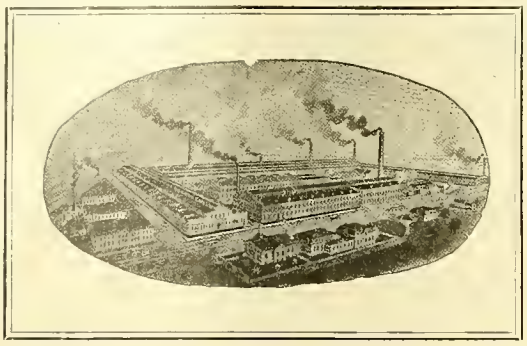

The Brush Double Arc Lamp Patents sustained by repeated decisions of U. S. Courts.

THE

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Agencies in all large cities.
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TROLLEY LINE INSULATORS,

TREE INSULATORS, ETC.

Tree Insulator.
Perfect Protection.

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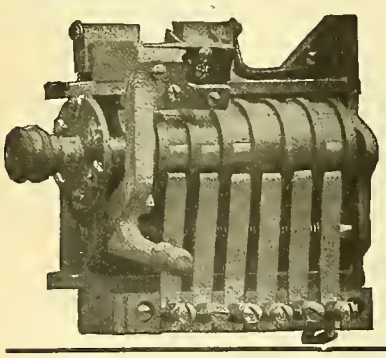
COMFORT. SAFETY.



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Regulating Switch Gives

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# THE HELIOS LAMP FOR STREET LIGHTING.

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Knoxville Electric Light and Power Co.

Knoxville, Ill., Feb 5 1894

Helios Electric Co
Philadelphia Pa

Gentlemen,- Your inquiry in regard to the Helios arc lamps received, and in reply would say that we are using 26 of your lamps for street lighting purposes and they are giving very good satisfaction. The lamps we are using are your regular half arc lamps. There was a test made a few days ago by an expert, and he gave his opinion that the lamps were giving the rated candle power. We would recomend them to any one desiring to use a street lighting system and especially where coal is dear. it would be much more economical to use the Helios lamp from the incandescent machine than to use a separate arc machine.

Yours truly
Knoxville Elec Lt & P Co.

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Southwestern Agents: ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis, Mo.
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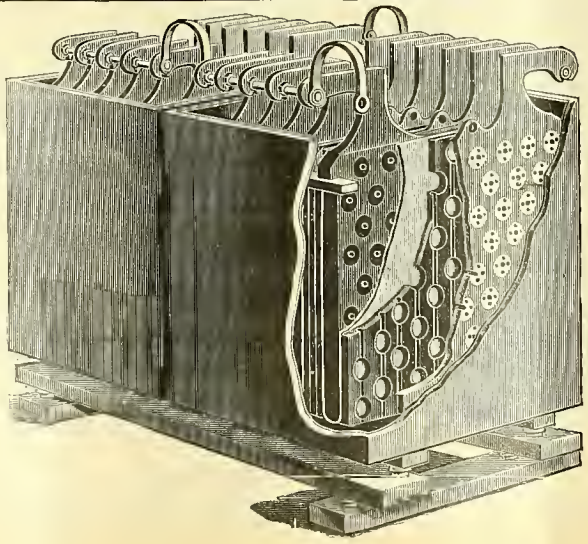

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*Cells from 10 to 5,000 amp. hours Capacity.*

Central Station and Traction Cells a Specialty.

BATTERIES FOR ISOLATED LIGHTING AND POWER PLANTS.

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Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
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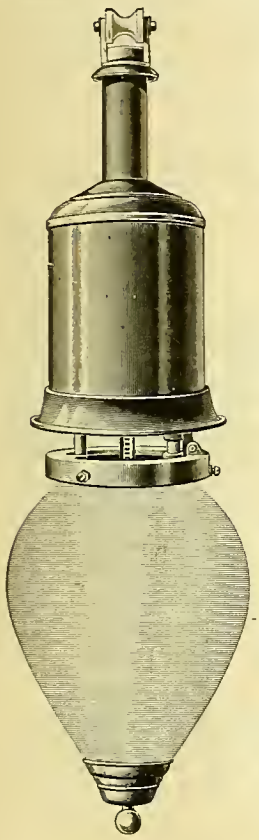

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You have seen our special offer on 1,000 "Ward" lamps, direct current. Well, the sale is fairly under way. If you desire anything in this line, let us hear from you quickly. State full particulars and quantity that you wish figures on.

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Established 1881.

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# TELEPHONE WIRE AND CABLES.

Every Telephone Company in the United States is using Kerite Wire and Cables. Kerite is the Standard of High Grade Insulation, and will Cut Last and Out Class any other on the Market.

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EXCLUSIVE DESIGNS.
LOW PRICES.

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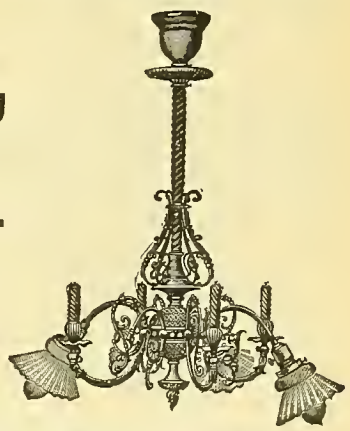

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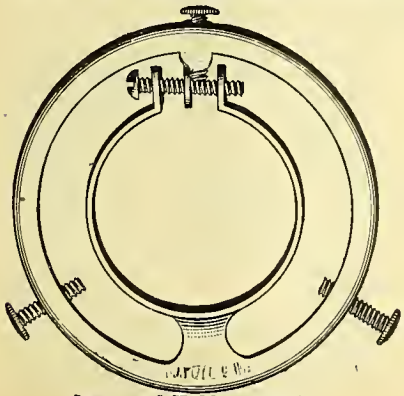

**Improved Holder. E404½. Will fit all sockets.**

*Big reduction in prices all through our line.*

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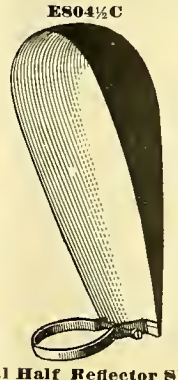
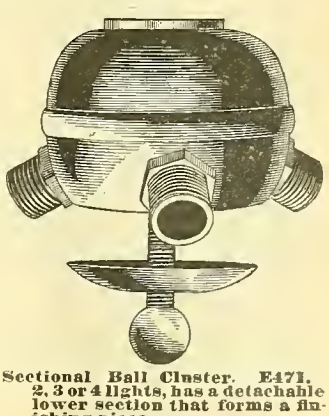


*Send for quotations and compare with the lowest.*

**Pat. pending. Metal Half Reflector Shade, Green Outside, White Enamel Inside. No extra holder necessary. Made to fit any socket.**



**Sectional Ball Cluster. E471. 2, 3 or 4 lights, has a detachable lower section that forms a finishing piece.**

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# BLOWING OUR HORN

We cannot refrain from congratulating ourselves on the fact that we are

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Is the most desirable on the market, and further than that we know how to handle all orders to the

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Cleats, 2 or 3 wire, glazed, $30. per 1,000
Insulators, " 12. " "
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WRITE FOR SAMPLES AND DISCOUNT.

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**The Dow Adjuster**

Is a thoroughly reliable mechanism for instantly raising or lowering an electric light. The lamp can be placed at any height as easily as a window shade can be raised or lowered.

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**DIRECT CURRENT MULTIPOLAR DYNAMOS AND GENERATORS.**

These machines are constructed with outside revolving armatures, without and with special commutator, as desired. They have proved remarkably efficient and economical. Used largely in European Central Stations. They are slow-speed machines, made for direct connection to engine without belting, and in sizes from 20 H. P. to 1,500 H. P.

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Are copied extensively in this country as "Drum Type." We are building these machines in sizes from 1 H. P. to 150 H. P.

**ALTERNATING AND MULTIPHASE CURRENT DYNAMOS**
With laminated field and armature, in sizes from 1 H. P. to 4,000 H. P., for belted or direct coupling.

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Of every speed for direct, alternating or multiphase current, in sizes from 1-10 H. P. up to 4,000 H.P. Durable and economical in operation.

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For direct and alternating current, for constant potential and series machines.

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With either solid or soft cores, which are the most economical in the world and give a steady light.

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Requisite for the regulation of electric apparatus; also the Siemens Voltmeters and Ammeters and Automatic devices made in Berlin.

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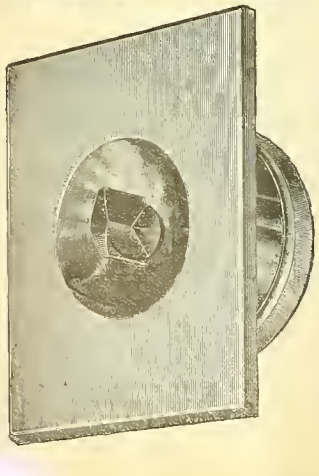
**HART FLUSH SWITCHES.**



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**The Only Snap Switch that has PROVEN A SUCCESS.**

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**Something New.**

The **Hoyt Standard Ammeters** and **Voltmeters** for **Lamp** and **Meter** measurement on **Alternating Currents** are now ready for the market.

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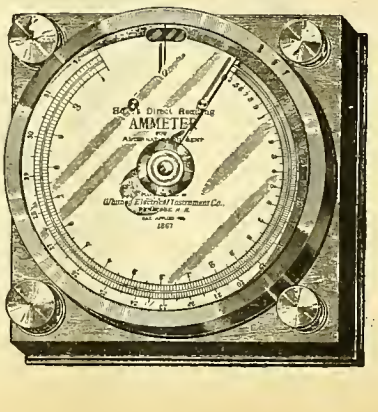

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RAILWAY FEEDER AND TROLLEY WIRE,

ELECTRIC LIGHT LINE WIRE,

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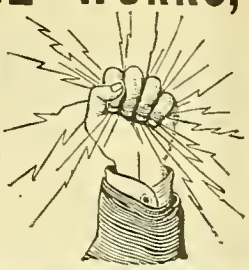
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



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The points or teats on the lower rim of the petticoat attracts the water on the outer surface of the insulator into drops. The water drops from these points on to the cross-arm, thereby preventing the moisture from creeping up on the inner petticoat, and thence to the pin. Owing to the great success of our Patent Teat Insulator in Telegraph Work, where the efficiency of the Insulator has proven to be more than twice that of the ordinary Insulator, we have concluded to apply the device to all Insulators for Telegraph, Telephone and Street Railway Work.

**Standard Screw Glass Insulators, Floor Insulators, Glass Break Knobs, Battery Jars, Arc Light Globes for all Systems. Colored Glass Insulators to designate different currents.**

WORK ON SPECIAL DESIGNS A FEATURE.
Send Model or Drawing and we will furnish estimates.

## HEMINGRAY GLASS CO.,

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Office, Covington, Ky. Factories, Muncie, Ind.

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TRADE MARK.

For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

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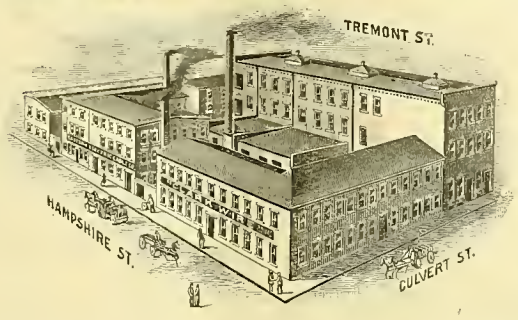


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We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first class Insulated Wire.

We shall be pleased to mail Catalogues with Terms and Discounts for Quantities.

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OPEN AND CLOSED CIRCUIT CELLS,
And Dealers in
Everything in the Battery Line.
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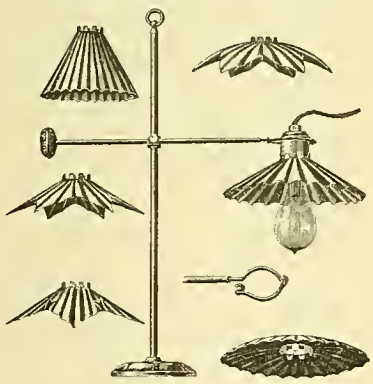

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**SHADES** (patented), made of thin, polished brass, lacquered, brilliant, beautiful, light and entirely new. Easily and securely adjusted to standard sockets. (No Collar.) Price $6 00 per doz. Good discount to trade.

**STANDS** (patents pending). Set screws, front and back, elevate, turn and hold the lamp at desired angle, saving the eyes. Price $2.50 each. Discount to the trade.

A set of samples (as shown in cut), sent on receipt of $3 00.

**Write for folder, etc.**

**Leading local supply houses appointed exclusive agents.**

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Dynamos and Motors and PARTS OF SAME
ALL KINDS PRICES OF PARTS TELEPHONES ELECTRICAL SUPPLIES
SEND STAMP FOR CATALOGUE PALMER BROS. MANUS, CONN.

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Licenses Granted.
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J. B. WEIS,
Analytical and Consulting Chemist
AND ASSAYER,
*Room 42, 81 Clark Street.*

☞Prices on application.

**Certificate of Analysis, No. 918.** Chicago, March 9, 1894.

**This Certifies** that I have analyzed sample of Sal Ammoniac, marked "A. G. Sal Ammoniac," submitted by Western Electric Company.

I find the amount of:

| | | | | | |
|---|---|---|---|---|---|
| Ammonium Chloride | contained | therein | to be | 99.51 | per cent. |
| Ammonium Sulphate | " | " | " | 0.03 | " |
| Moisture | " | " | " | 0.13 | " |
| Non-Volatile Matter | " | " | " | 0.02 | " |
| Organic Matter | " | " | " | 0.31 | " |

The Non-Volatile Matter consists of Iron Oxide and Alumina.

Signed, J. B. WEIS.

# WESTERN ELECTRIC CO., CHICAGO.

# Chicago General Fixture Co.,

169 ADAMS STREET, CHICAGO.

## Electric Supplies,
## Electric Fixtures,
## Combination Fixtures.

We Can Save You Money. Write for Quotations.



## FOR SALE.

The entire stock of brnsh copper of the late Aosonia Electric Co., 5,000 lbs., all sizes, at fifteen cents ($0.15) per pound. Porcelain cut-outs, Edison make, all sizes, at 75 per cent off Edison list. Bryant switches, 15 ampere, double pole, 60c. Sawyer-Man 10 ampere main cut-oots at 15c. Write us for **anything** you want, and we may have it

**Chas. E. Gregory Co.,**
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## FOR SALE.

A new electric light plant making good money. Expenses low; franchises for long terms; income increasing steadily; good locality; no better business in the place. Good reasons for selling. Address

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## FOR SALE.

A good chance for an energetic young electrician wishing to purchase an established business with messenger service connected. Present owner having other business, cannot give it attention. A bargain if taken at once. For full particulars apply to

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## FOR SALE.

The Hillsboro Gas and Electric Light Plant, consisting in part of two 35 light T.-H. Arc Dynamos; two 100 horse power boilers; one 74 and one 100 horse power engine; sixty eight 2,000 candle power T.-H. arc lamps; one 300 light alternator with 250 lamps in place; 3½ miles of gas main; two benches for three retorts each; one 30,000 ft. gas holder; one hundred and fifty gas consumers, both the above with all the machinery necessary to make a first-class plant. Will be sold at public sale, on Wednesday, Aug. 1, 1894. J. M. HUGHEY, Receiver of the Hillsboro Gas & Electric Light Co., Hillsboro, Ohio.



**For Rent—In THE BELDEN, 295, 297, 299 Belden Avenue, Corner Fremont Street, short distance west of Lincoln Park, Chicago.**

A seven room CORNER flat with all modern appointments, including steam heat, janitor, gas range, gas grates and logs, hot water, refrigerator, side-board, three wood mantels, handsome oak and marble entrance, private storeroom and laundry; every room as light as day; the only vacant flat in the building; rent reduced to $50.00. J. B. Carney, on premises, or at 6 Lakeside Building.



## Summer Resorts of Wisconsin.

Excursion tickets to the Summer Resorts of Wisconsin are now on sale by the Chicago, Milwaukee & St. Paul Railway. Special low rates on Friday and Saturday of each week for tickets good to return until Monday. For further information apply at Ticket Office, 207 Clark St, or Union Passenger Station, Canal, Adams and Madison Sts



THE WONDERFUL

## D'Unger Telephone.

**Highly Important to Telephone Users.**

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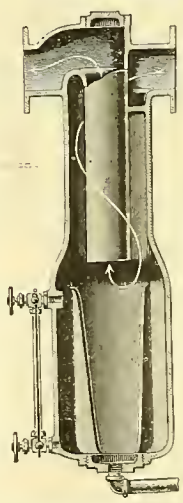

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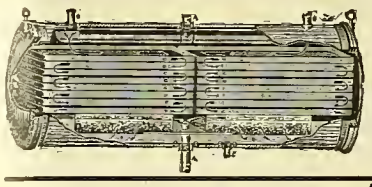

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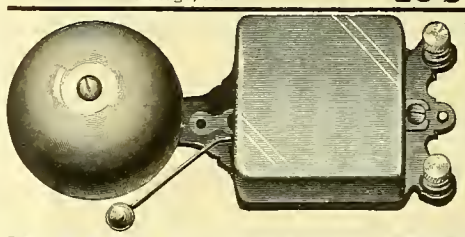

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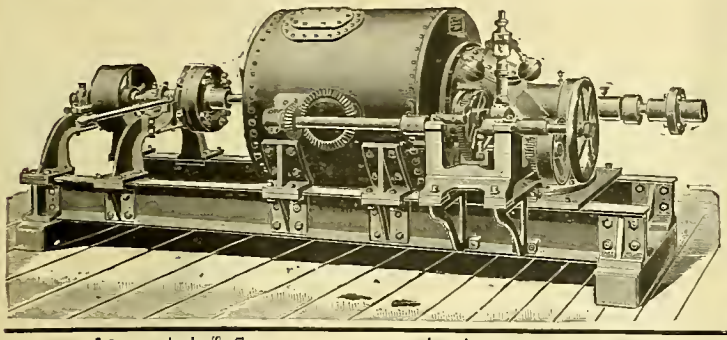

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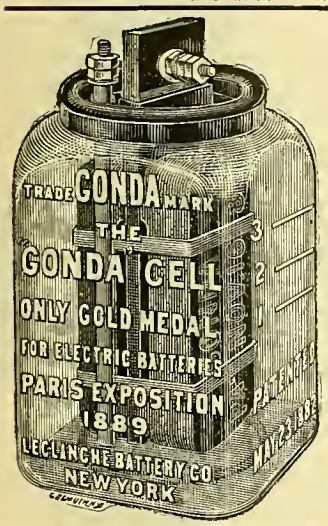


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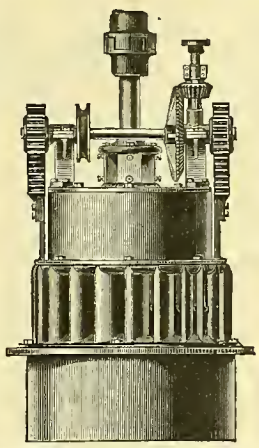

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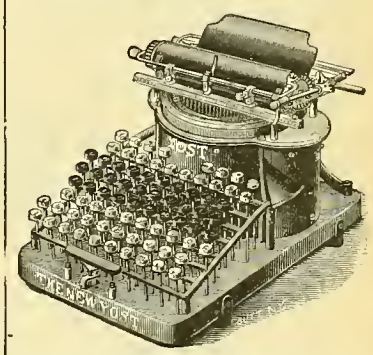


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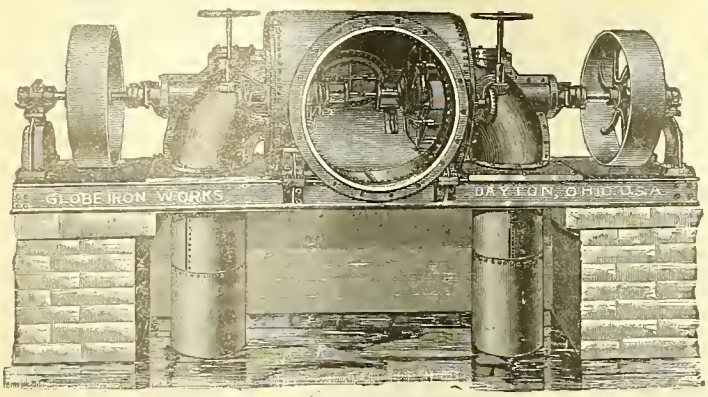


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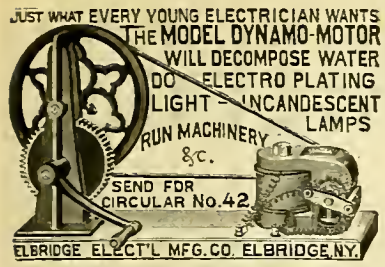


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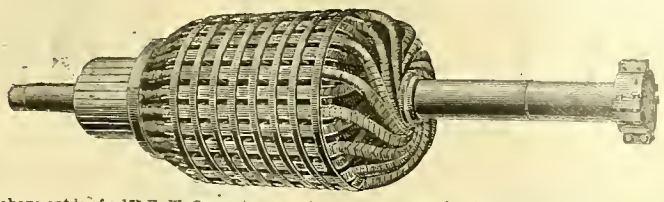

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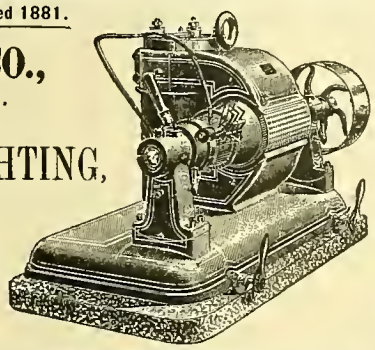

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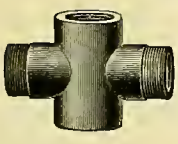

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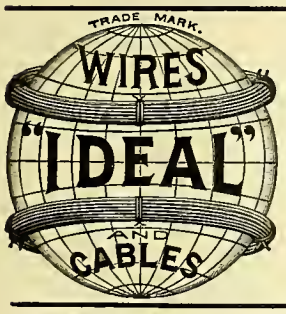


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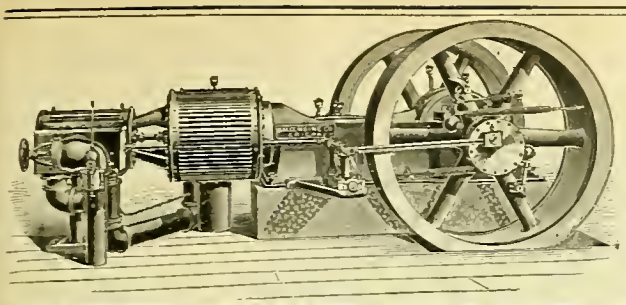

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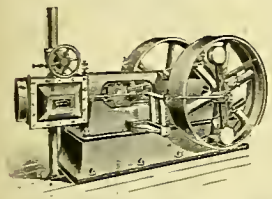

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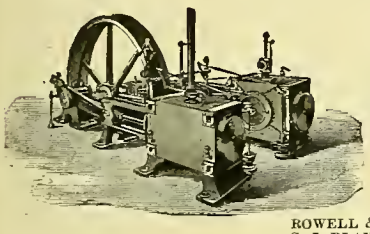

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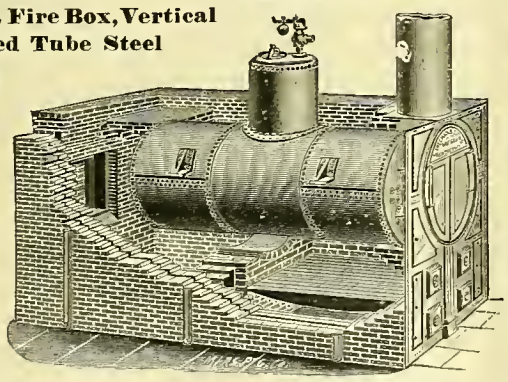

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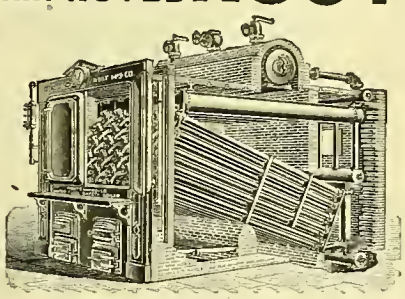

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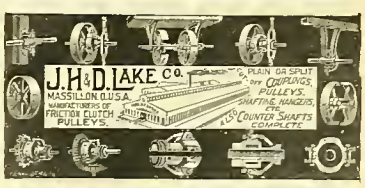


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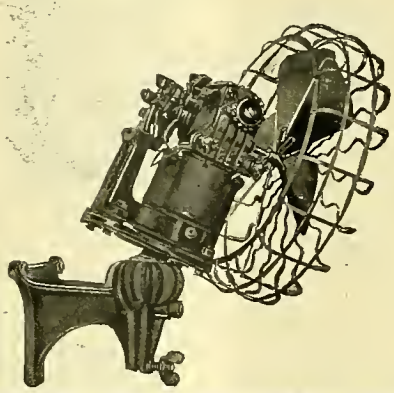

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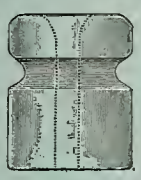

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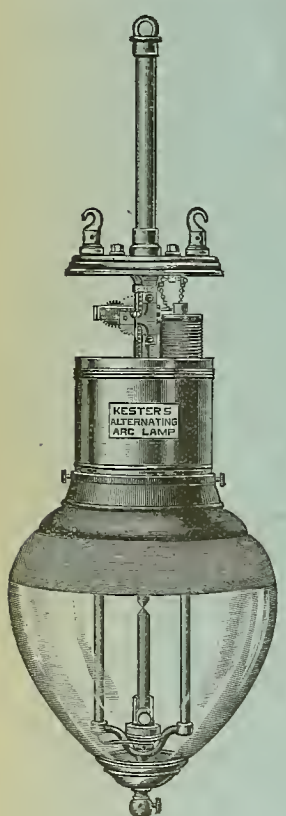


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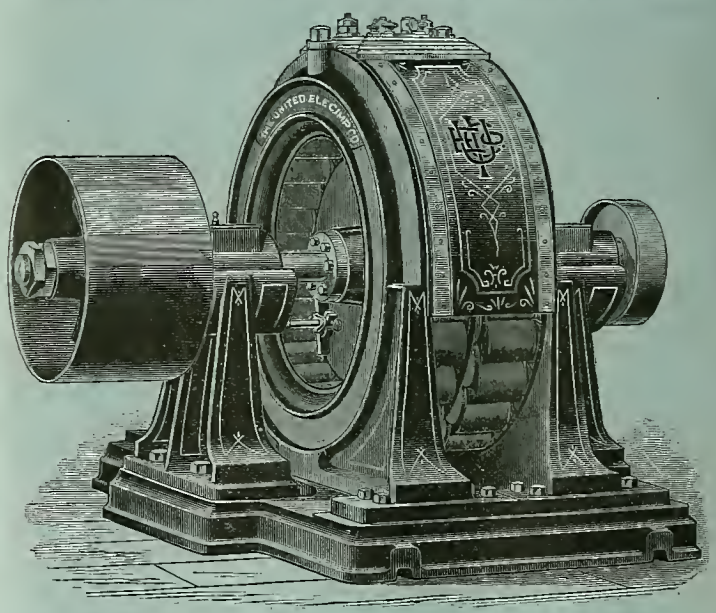


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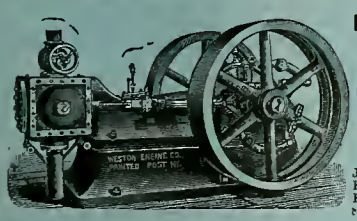

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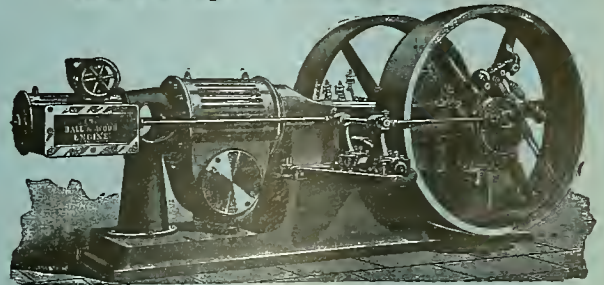

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**Manufacturers of High Grade Wires and Cables.**

Simplex T. Z. R. Weatherproof Wires.
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Simplex Mining Wires.
Simplex Lead Covered Cables.
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*Write for Prices.*

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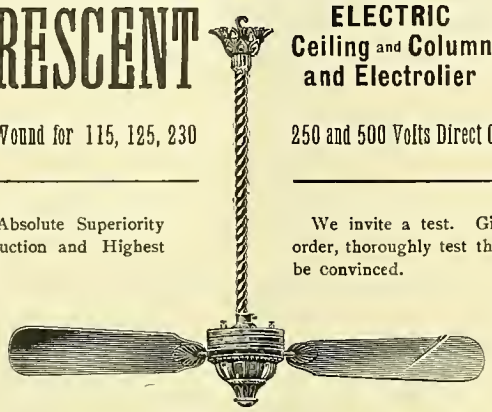
THE CRESCENT ELECTRIC Ceiling and Column and Electrolier FANS

Are Wound for 115, 125, 230 — 250 and 500 Volts Direct Current.

We claim Absolute Superiority of Construction and Highest Efficiency.

We invite a test. Give us a sample order, thoroughly test the Crescent, and be convinced.



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Manufacturers of Electrical Specialties,

AGENTS WANTED. Lancaster, Pa.

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NO BELTS. NO SHAFTING.

CEILING, FLOOR COLUMN, COUNTER COLUMN FANS FOR DIRECT CURRENT.

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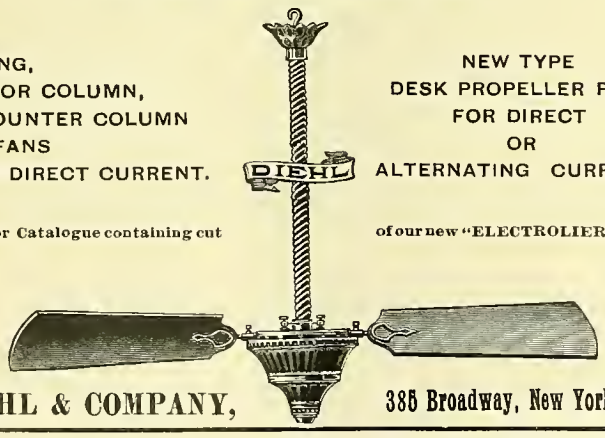


NEW TYPE DESK PROPELLER FANS FOR DIRECT OR ALTERNATING CURRENT.

of our new "ELECTROLIER" FAN.

**DIEHL & COMPANY,** 385 Broadway, New York City.

STEPHEN B. ELKINS, Prest. PATRICK EGAN, Sec'y. H. J. HANFORD, Gen'l Mgr.

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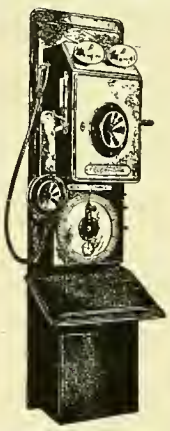
AGENTS' TERRITORIES NOW BEING ALLOTTED. WRITE AT ONCE.



WHAT MONEY CAN EARN AND THE PEOPLE SAVE BY MEANS OF THE

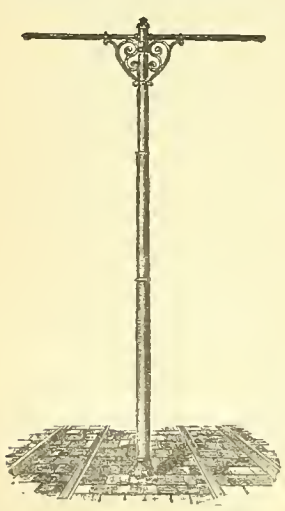
Harrison International Telephone.

**We either sell our telephones outright or lease them for a term of years.**

This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Patent No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete electric speaking telephone operated by battery; and owns Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

Prospectuses furnished by addressing the Company at their offices,

Offices, Chamber of Commerce Bldg., Chicago.



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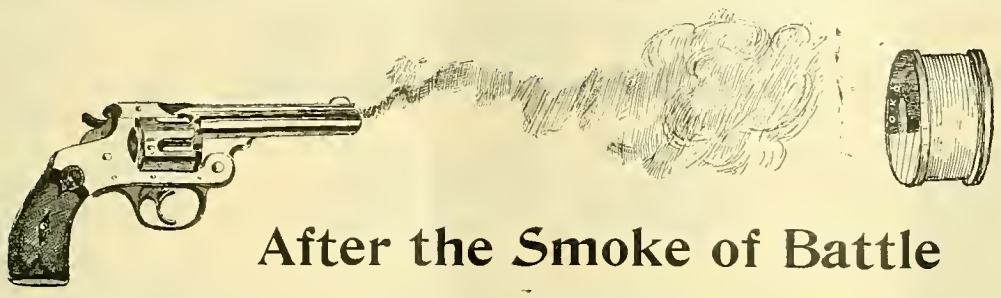
Manufacturers of

# Boiler Tubes, Wrought Iron Pipes and Fittings.

ELECTRIC LIGHT and RAILWAY PIPE POLES A SPECIALTY.



OKONITE TRADE MARK.

## After the Smoke of Battle

has cleared away you will find **Okonite** just where it has always stood—in the front rank—ahead of all others—unscathed. No matter how hard the conflict, nor what the service, nor where the rub comes, you can safely send Okonite and Candee Wires into the thickest of the fight, depending upon them to *win.* THEY NEVER DISAPPOINT.

**Body Guards?** Well, these wires don't particularly need any, but if you aim for the highest mark of safety, use INTERIOR CONDUITS. The pioneer of conduits, nothing equals it for absolute insulation, for convenience of interior construction. Nothing stands so high in the estimation of leading Engineers, Wire Workers and the Underwriters.

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Nothing will cool things off so effectually as a LUNDELL FAN. Perhaps you haven't sent us the order we are looking for—*do it to-day.* We can supply every size for any purpose, from blowing up a derelict governor to cooling off a hot-headed rioter.

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We have the largest stock—the most perfect assortment of Electrical House Goods. If you are going to bid on a contract, consult our Catalogue first.

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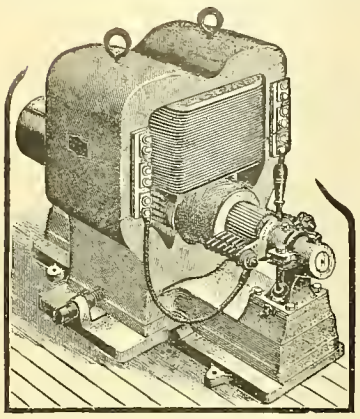
Southern Electrical Supply Co., St. Louis.

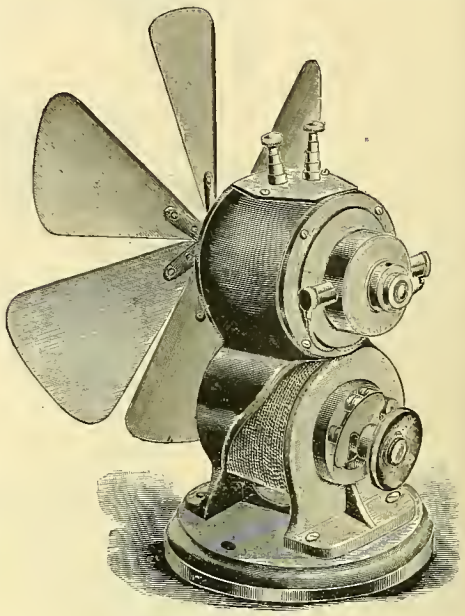
The Central Electric Company,
173-175 Adams Street,
CHICAGO.

# Muncie Electrical Mfg. Co.,

Manufacturers of the **MUNCIE**

## Steel Magnet MOTORS and DYNAMOS.





1 to 50 Horse Power Motors.
18 to 700 Lights' Capacity Dynamos.

**Send for Catalogue.**

**PRICE, $16.00.**
**Discount According to Order.**

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# We Want Western Business.

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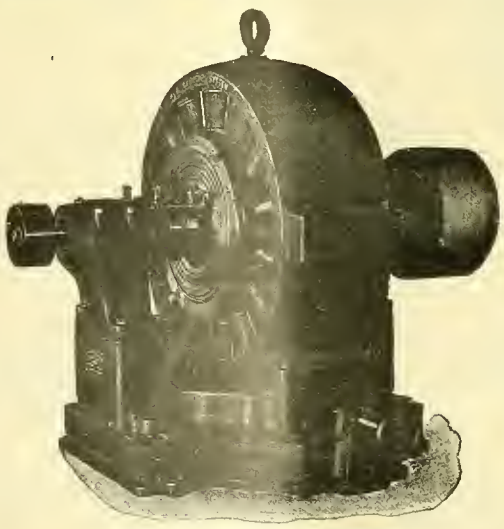
MANUFACTURED IN SIZES FROM

*25 to 5,000 Lights,*

SINGLE OR MULTIPHASE.

Direct Connected Dynamos.

Direct Current Generators.



1,000 Light Alternator.

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**OWEN FORD, Rialto Building,**
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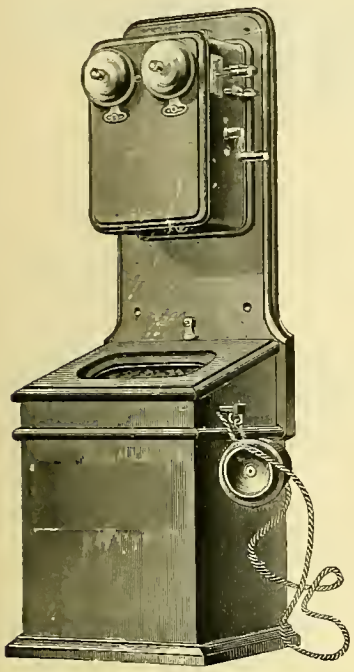

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**Patents Fundamental Non-Infringing.** **THE LATEST AND BEST.**

- Long Distance Battery Transmitters of the latest and newest designs sold outright.
- No adjustment.
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- Nothing demanding repair.
- Will Convey articulate speech 1,000 miles.
- Constructed of the best material.

- A Telephone Receiver of the newest and best pattern.
- Unique in design.
- Perfect in action.
- Moderate in cost.
- Small instruments made of the finest rubber.
- All wires and connections within the case.
- No unsightly thumb-screws.

This Company owns the patent for the improved switch for changing the circuit of the telephone on battery transmitters. Also, for perfected system of telephone exchanges. The best dry battery manufactured.

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# TWO PHASE GENERATORS

Entirely novel in construction and having

**No Moving Wire, No Collector, Slow Speed,**
**Better Inherent Regulation, Higher Efficiency,**

Than any alternating machine on the market.

## SELF-STARTING TWO PHASE MOTORS.

Superior in many ways to direct current motors.

## The Best Transformer.

These are the essential elements in our

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Which is the only practically completed system in operation to-day for furnishing light and power from the same generator and circuit.

If you have not already received it send for **OUR NEW CATALOGUE.**

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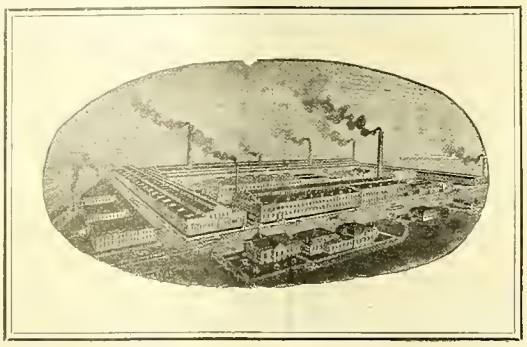
Electric Lighting and Power Apparatus.



The Brush Double Arc Lamp Patents sustained by repeeted decisione of U. S. Conrts.

THE

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Agencies in all large cities.
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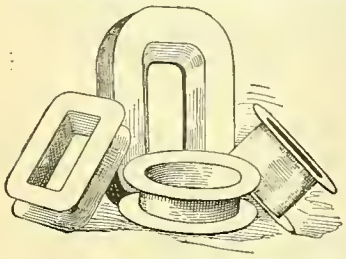
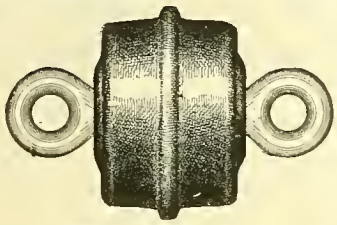
# VULCABESTON,

## Field Magnet Spools, Bushings, Controller Pieces, Etc.





Giant Strain Insulator.
Average breaking strain 6,500 lbs.

MOULDED MICA Trolley Line Insulators.

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# Consolidated Car-Heating Co.,

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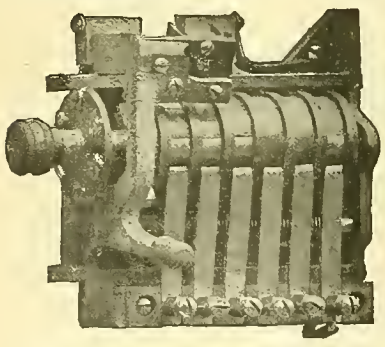
**COMFORT.** **SAFETY.**



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Regulating Switch Glves

FIVE DIFFERENT INTENSITIES OF HEAT.

**In Practical Operation in More Than 25 Leading Cities in U. S. and Canada.**

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# THE HELIOS LAMP FOR STREET LIGHTING.

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Knoxville Electric Light and Power Co.

Knoxville, Ill., Feb 5 1894

Helios Electric Co
Philadelphia Pa

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Yours truly
Knoxville Elec Lt & P Co.

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## MANUFACTURING COMPANY.

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**TROLLEY HARPS,** Brass, Bronze, Malleable Iron or Steel. Light, strong, new design. Cheapest and best on the market.

**BEARINGS** For Dynamos and Motors. We guarantee 20 per cent. more life than any anti-friction metal offered for sale.

**Line Ears, Splicing Ears, Curve Pull-Offs, Single and Double Connectors.**

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Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

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20 Lights, $20.00—10 per cent. off if 100 Lights are ordered.
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| Converters: | | Meters: | |
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| 5 Lights, | $ 8.00 | 10 Lights, 10 Amperes, | $10 00 |
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GENERAL ELECTRICAL SUPPLIES.

## TELEPHONE WIRE AND CABLES.

Every Telephone Company in the United States is using Kerite Wire and Cables. Kerite is the Standard of High Grade Insulation, and will Cut Last and Out Class any other on the Market.

SEND FOR SAMPLES AND PRICES.

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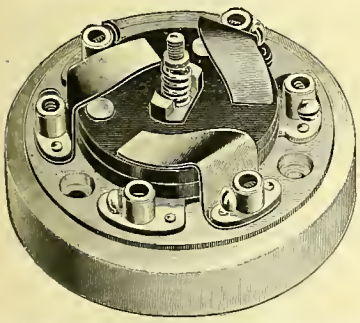

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EDISON 3-WIRE SYSTEM.

This Switch is made to meet the recent requirements of National Board of Underwriters and breaks each of the three wires simultaneously in two places.

It is the Latest Production of

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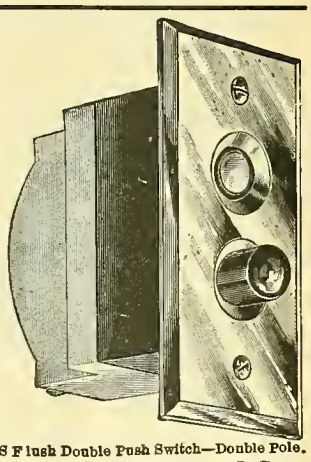

C-S Flush Double Push Switch.
Single Pole—Double Pole—Commutation; 3 Wire, 4 Wire.

C-S Flush Key Switch.
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C-S Flush Automatic Switch.
Single Pole.

ELECTRICALLY
MECHANICALLY
ARTISTICALLY
PEERLESS.

C-S Flush Double Push Switch—Double Pole.

THE CUTTER ELECTRICAL & MFG. CO.,

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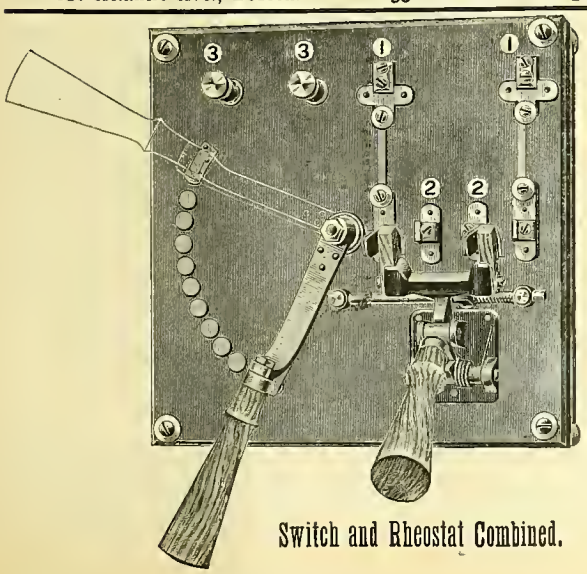

Switch and Rheostat Combined.

## PROTECT YOUR MOTORS

BY USING THE

## Hill Patent Self-Locking Starting Switch.

No possible chance for an accident, as the Switch cannot be closed until the resistance is all in.

CHEAP. COMPACT. DURABLE.

Made only by the

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Guaranteed Over 99 Per Cent. Fure.

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Suitable for all Incandescent Dynamos, P'ating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.

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For Incandescent Dynamos, Plating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.

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Apparatus for every purpose, and for use on every current.

Our Arc Lamps can be used on any current whatever.

The BISHOP GUTTA-PERCHA CO.

THE BEST GRADES OF

Wire and Cables

For under ground, under water, and all other conditions.

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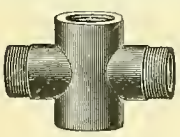

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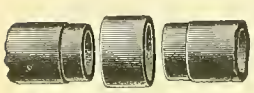

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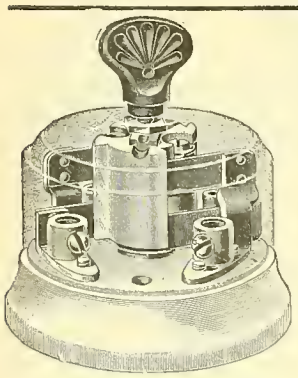

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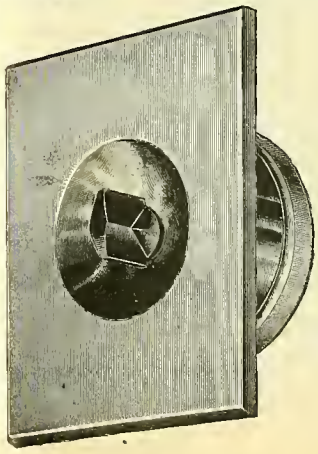

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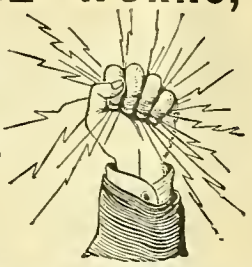

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The points or teats on the lower rim of the petticoat attracts the water on the outer surface of the insulator into drops. The water drops from these points on to the cross-arm, thereby preventing the moisture from creeping up on the inner petticoat, and thence to the pin. Owing to the great success of our Patent Teat Insulator in Telegraph Work, where the efficiency of the Insulator has proven to be more than twice that of the ordinary Insulator, we have concluded to apply the device to all Insulators for Telegraph, Telephone and Street Railway Work.

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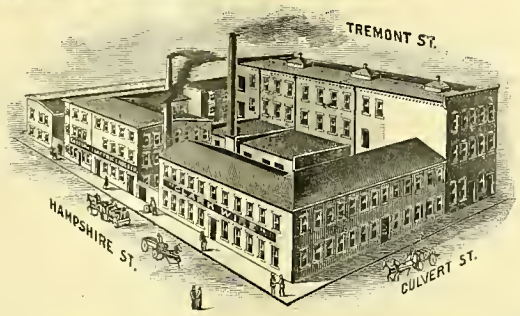


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AND ASSAYER,
*Room 42, 87 Clark Street.*

**Certificate of Analysis, No. 918.** Chicago, March 9, 1894.

**This Certifies** that I have analyzed sample of Sal Ammoniac, marked "A. G. Sal Ammoniac," submitted by Western Electric Company.

I find the amount of:

| | | | | | |
|---|---|---|---|---|---|
| Ammonium Chloride | contained | therein | to be | 99.51 | per cent. |
| Ammonium Sulphate | " | " | " | 0.03 | " |
| Moisture | " | " | " | 0.13 | " |
| Non-Volatile Matter | " | " | " | 0.02 | " |
| Organic Matter | " | " | " | 0.31 | " |

The Non-Volatile Matter consists of Iron Oxide and Alumina.

Signed, J. B. WEIS.

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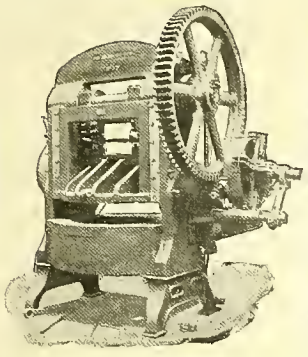

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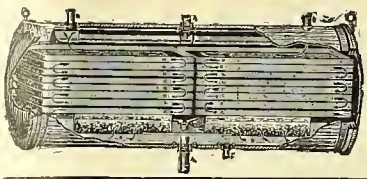

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**Are the only Electric Lighters made that are successfully operated by the key,**

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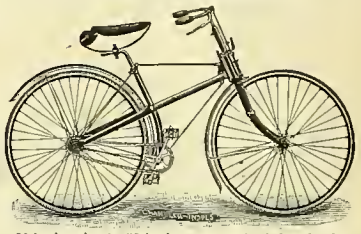

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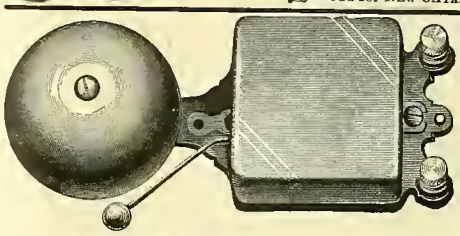

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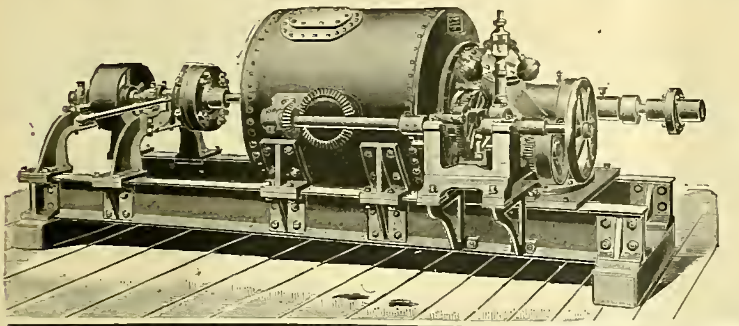

Cylinder or Register Gate—Close Regulation and High Efficiency at Full and Partial Gate.

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter**, being **double** the **power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

***SEND FOR CATALOGUE AND PARTICULARS.***

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A word of only two letters, generally of no importance except for its conjunctive properties, but sometimes having such an important bearing that it feels itself as big as the initiative word to the German language, *i. e.*: Constantinopolitanischerdudelsackspfeifermachergesell for example.

**IF** I have to guarantee my work I always use the Law Double Cylinder Cell.

**IF** I wish a cell that will give me a "dead cinch" on Holding-up power in combination with Uniformity of Current, which is bye-the-bye significant of eventual economy, I always purchase the Law Double Cylinder Cell.

**IF** There is a Telephonist, Bellhanger, Railroader, an Electrician, or anyone else who denies the Efficiency, Durability or Capability of the Law Double Cylinder Cell, I challenge him to open debate.

Trusting that we have made clear to you through above remarks of a customer of ours the importance at times of the little word under consideration, we are yours truly,

**LAW BATTERY COMPANY,**

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**Acid Cells, Plunge Batteries, Zincs, Sal Ammoniac, Carbon Plates, Etc**

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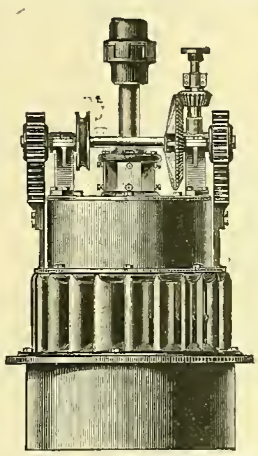

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On Vertical or Horizontal Shaft, Especially Adapted for Electric Work.

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Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with me, as **I am willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

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Estimates furnished for complete power plants and results guaranteed.

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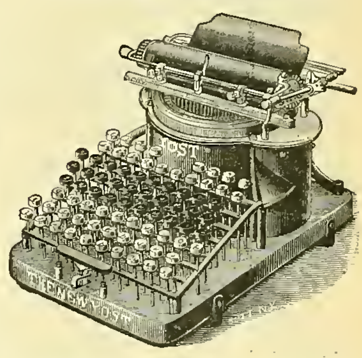


Constructed on principles radically its own, insuring results always sought for but absolutely unattainable in the construction of any other machine. It is pre-eminently the telegrapher's and professional stenographer's typewriter.

Let us send you catalogue.

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**Power Generators for Lighting and Railway Purposes.**

**Complete Station Equipments.**

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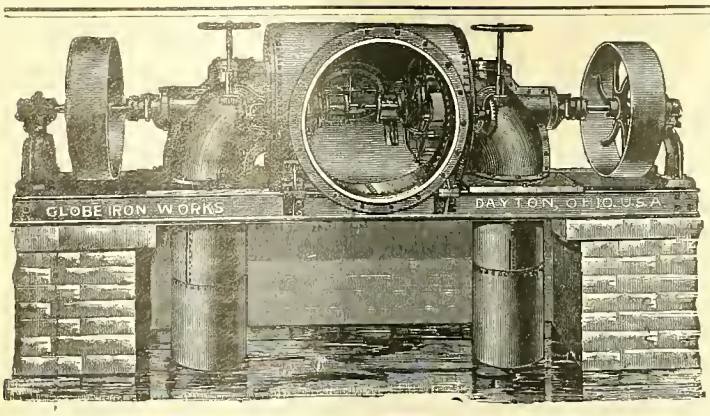


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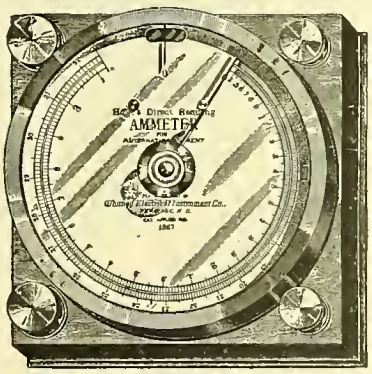


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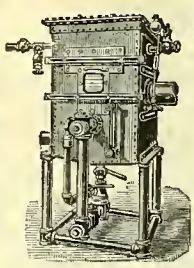

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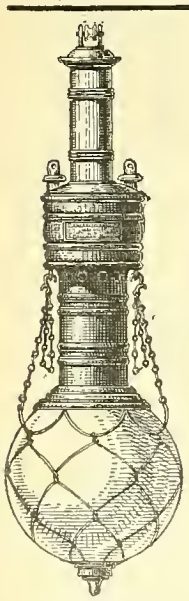

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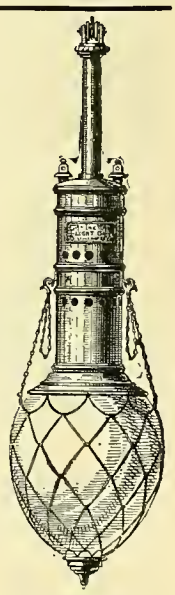

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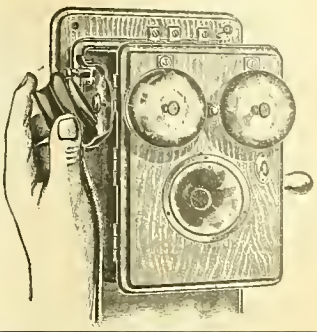

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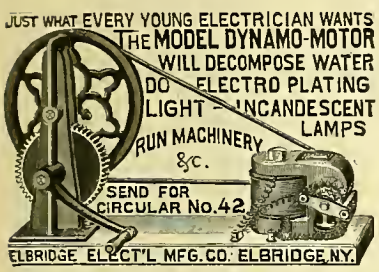


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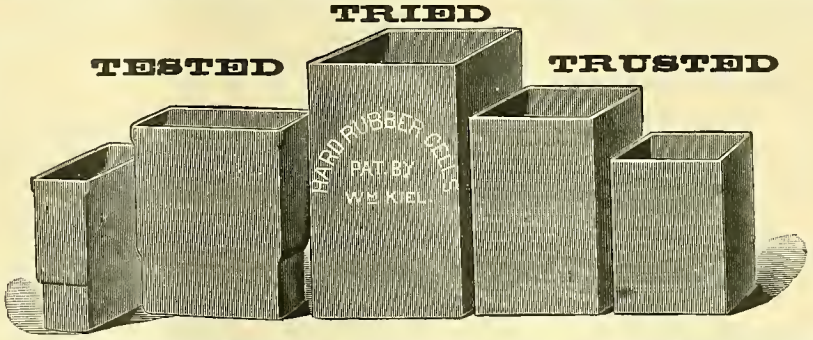


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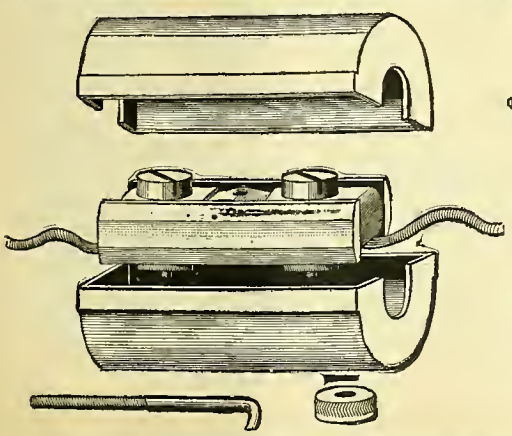

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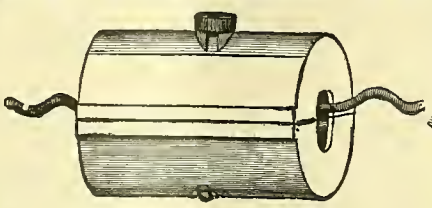

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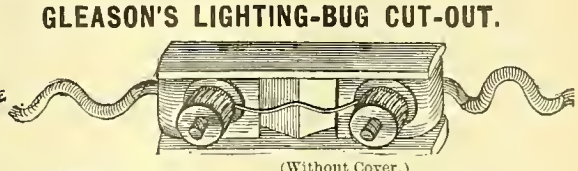

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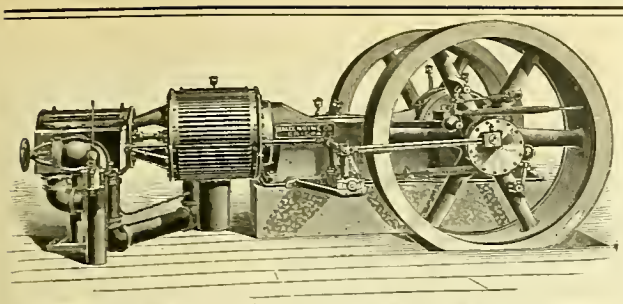

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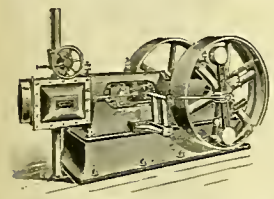

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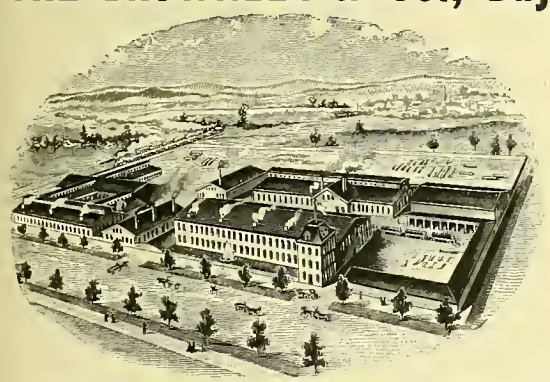

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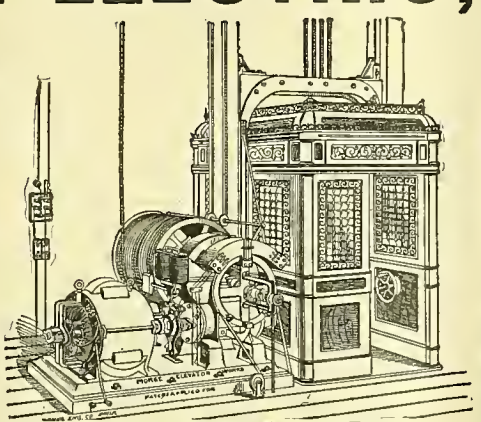

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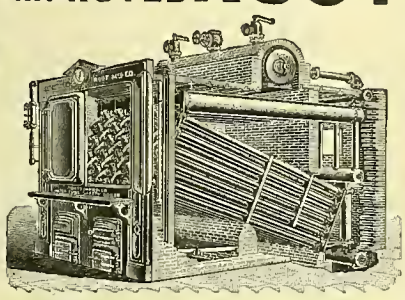

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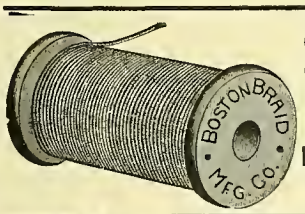


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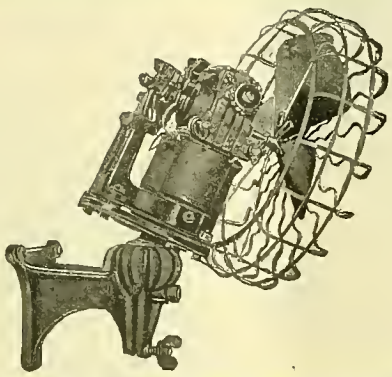

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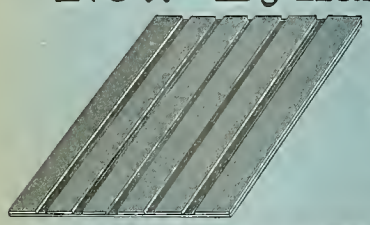

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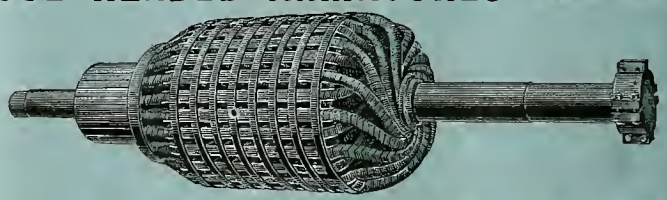

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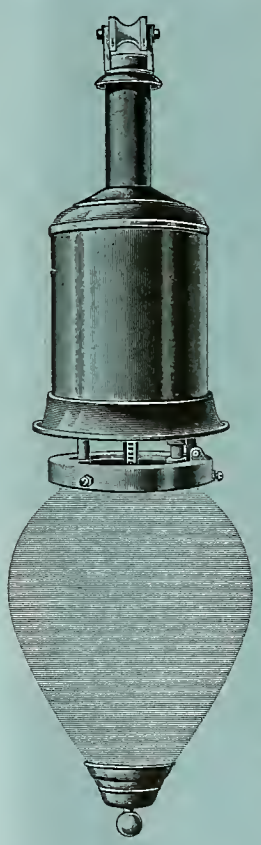

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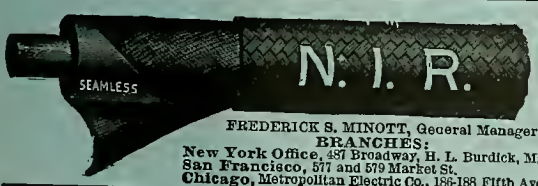


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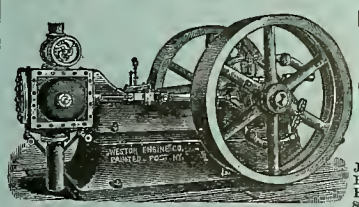

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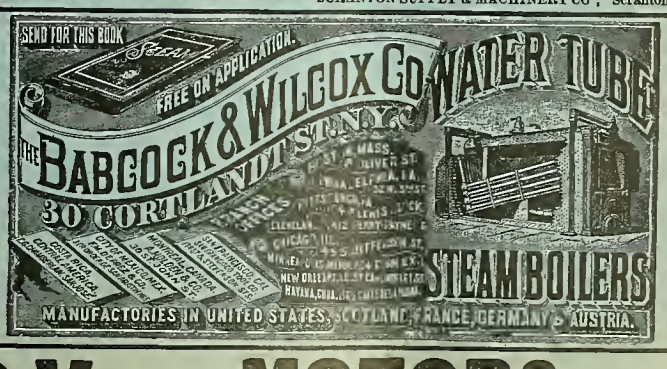


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**Accumulators.**
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Cons. Electric Storage Co.
Electric Storage Battery Co

**Adjusters, Lamp.**
Dow Adjuster Co.

**Associations.**
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Electric Cons. & Supply Co.
General Electric Co.
General Ind'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Arm tu e Winders.**
Hartley Elec. Wks.
Rush ore, S. W.
Stanwood Mf'g Co.

**Batteries and Jars.**
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Bard Rubber Co.
Central Electric Co.
Electric Appliance Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hemingray Glass Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Washington Electric Co.
Western Electric Co.

**Belting.**
Shultz Belting Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co., The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Fulton Steam Boiler Wks.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electrician Publishing Co.

**Brushes.**
Partridge Carbon Co.
Wirt, Chas.

**Burglar Alarms.**
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric.** (See Insulated Wires). **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
Hill, W. S. Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Rafferty & Co., T. C.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons Points & Plates.**
Central Electric Co.
General Electric Co.
Metropolitan Electric Co.
Partridge Carbon Co.
Western Electric Co.

**Car-Heaters, Electric.**
Consolidated Car-Heating Co.

**Conduits**
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Hartley Elec. Wks.
Johnson, Montgomery H.
Muncie Elec. Mfg. Co.
Osburn, Harry G.
Stone, O. M.
Washington Electric Co.
Wirt, Chas.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
La Roche Electric Wks.
Mather Electric Co.
Monrath, Gustave.
Muncie Elec. Mfg. Co.
Osburn, Harry G.
Roberts & Co., E. P.
Siemens & Halske Elec. Co.
Stone, O. M.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Rafferty & Co., T. C.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Electric Appliance Co.
Hub ey Mfg. Co.
Metropolitan Electric Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Great Western Mfg. Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Hubley Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Perkins Elec. Switch Mfg. Co.
Sioux City Brass Works.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
General Electric Co.
Great Western Mfg. Co.
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Royal Electric Co.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Electric Railways.**
Brush Electric Co.
General Electric Co.
Hubley Mfg. Co.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Cameron & Gillett.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Johnson, Montgomery H.
Merrill, Frederick L.
Monrath, Gustave.
Osburn, Harry G.
Roberts & Co., E. P.
Stone, O. M.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Metropolitan Electric Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
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Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Great Western Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Weston Engine Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Central Electric Co.
Crescent Electric Co.
Diehl & Co.
Muncie Elec. Mfg Co.

**Fibre**
American Hard Fibre Co.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.

**Gears.**
Grant, Geo. B.

**General Elec. Supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Crescent Electric Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Great Western Mfg. Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Caoot Electric Co.
Hubley Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Palmer Bros.
Rafferty & Co., T. C.
Sioux City Brass Works.
Washington Electric Co.
Wallace Electric Co
Western Elec. Supply Co.

**Globes and Electrical Glassware**
Chicago Gen'l Fixture Co.
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Hemingray Glass Co.
Hubley Mfg. Co.
Phœnix Glass Co.

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Hubley Mfg. Co.

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American Hard Fibre Co.
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Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Bard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Great Western Mfg. Co.
Hart & Hegeman Mfg. Co.
Hemingray Glass Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Paint Co.
Vulcanized Fibre Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Great Western Mfg. Co.
Hubley Mfg. Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Rafferty & Co., T. C.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Great Western Mfg. Co.
Mather Electric Co.
Metropolitan Electric Co.
New York & Ohio Co.
Rafferty & Co., T. C.
United Elec. Imp. Co.
Westinghouse Elec. & Mfg. Co.

**Lightning Arresters.**
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Wirt, Chas.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery.**
Bliss Co., E. W.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co

**Motors.**
Bolgiano Mfg. Co.
Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
General Electric Co
Great Western Mfg. Co.
Gregory, Chas. E. Co
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Royal Electric Co.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co.

**Paints.**
Standard Paint Co.

**Phosphor Bronze.**
Phosphor Bronze Sm. Co. Ltd.

**Platinum.**
Baker & Co.

**Pole .**
Brownlee & Co.
Morris, Tasker & Co.

**Porcelain.**
Empire China Works.
Chicago Gen'l Fixture Co.
General Electric Co.
Phœnix Glass Co.

**Publishers, Electrical.**
Electrician Publishing Co.

**Push Buttons.**
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.

**Rheostats.**
General Electric Co.

**Sal ammoniac**
Hayden-Booker Mfg. Co.
Innis & Co.
Klipstein, A. & Co.
Law Battery Co.

**Second-Hand Electrical Machinery.**
Gregory, Chas. E. Co.

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Boston Braid Mfg. Co.

**Slate.**
Independent lectric Co.

**Speaking Tubes.**
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.

**Speed Indicators**
Whitney Elec. Instrument Co

**Steam Heating.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Steam Pumps.**
Worthington, Henry R.

**Storage Batteries.**
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric Storage Battery Co.

**Stoves, Electric.**
Consolidated Car-Heating Co.

**Street Cars.**
Brill, J. G. Co.

**Tapes, Insulating.**
American Electrical Works.
Central Electric Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Chicago Ins. Wire Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Stone, O. M.
Western Electric Co.

**Telephones.**
Columbia Tele. Mfg. Co.
D'Unger Long Dist. Tel. Co.
Harrison Int. Telephone Co.
National Tele. Mfg. Co.
Palmer Bros.
Western Electric Co.
Western Tel. Const. Co.

**Transformers**
General Electric Co.
Bornberger Elec. Mfg. Co.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Trucks, Electric Car.**
General Electric Co.
Westinghouse El. & Mfg. Co.

**Turbine Wheels.**
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Smith, S. Morgan.
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**Water Wheels.**
Leffel & Co , Jas.
Smith, S. Morgan.

**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Crescent Ins. Wire & Cable Co
Electric Appliance Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.

CHICAGO,
1137-1138 Monadnock.

# THE SIMPLEX ELECTRICAL Co.

BOSTON,
75-81 Cornhill.

**Manufacturers of High Grade Wires and Cables.**

**Simplex T. Z. R. Weatherproof Wires.**
**Simplex Braided Caoutchouc Wires.**
**Simplex Mining Wires.**
**Simplex Lead Covered Cables.**
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*Write for Prices.*

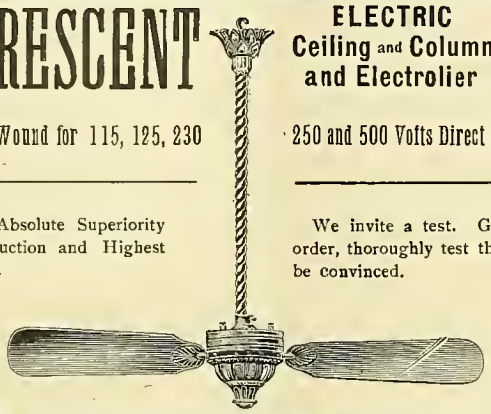
**Western Selling Agent, H. R. HIXSON, 1137 and 1138 Monadnock, CHICAGO. Tel. Harrison 305.**

THE CRESCENT ELECTRIC Ceiling and Column and Electrolier FANS

Are Wound for 115, 125, 230 250 and 500 Volts Direct Current.

We claim Absolute Superiority of Construction and Highest Efficiency.

We invite a test. Give us a sample order, thoroughly test the Crescent, and be convinced.



**THE CRESCENT ELECTRIC CO.,**
Manufacturers of Electrical Specialties,
AGENTS WANTED. Lancaster, Pa.

# THE DIEHL ELECTRIC FANS.

NO BELTS. NO SHAFTING.

CEILING,
FLOOR COLUMN,
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FANS
FOR DIRECT CURRENT.

NEW TYPE
DESK PROPELLER FANS
FOR DIRECT
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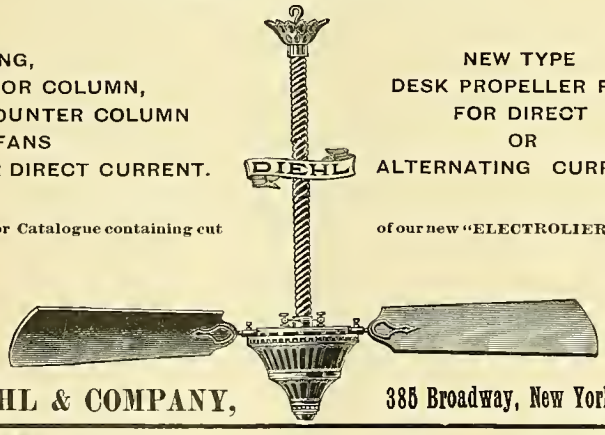
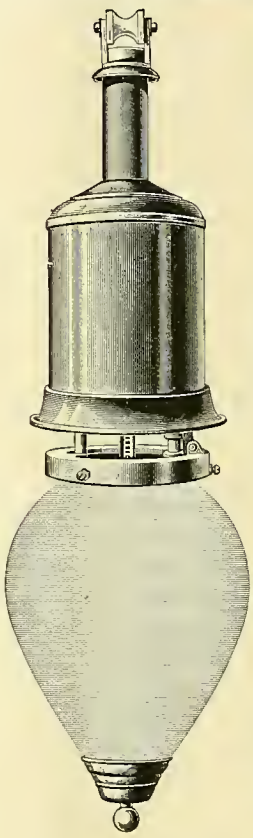
ALTERNATING CURRENT.

Send for Catalogue containing cut of our new "ELECTROLIER" FAN.




DIEHL & COMPANY, 385 Broadway, New York City.

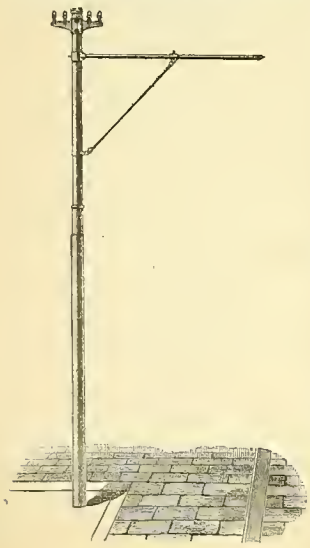


# STANDARD "WARD" ARC LAMPS.

You have seen our special offer on 1,000 "Ward" lamps, direct current. Well, the sale is fairly under way. If you desire anything in this line, let us hear from you quickly. State full particulars and quantity that you wish figures on.

## Electric Construction & Supply Co.,

Telephone Building, New York. Established 1881. Unity Building, Chicago.



1821. 1888.

# MORRIS, TASKER & CO.,

INCORPORATED.

Offices, 222-224 S. Third St., Philadelphia, Pa.

PASCAL IRON WORKS, PHILADELPHIA.

DELAWARE IRON WORKS, NEW CASTLE, DEL.

Manufacturers of

## Boiler Tubes, Wrought Iron Pipes and Fittings.

ELECTRIC LIGHT and RAILWAY PIPE POLES A SPECIALTY.

DOUBTLESS many such experiences, as the one related in the next column, could be given, but electrical engineers have become so accustomed to doing battle with the elements, and so used to depending upon Okonite to carry them through a "tight pinch" that they think nothing of it and hold their peace.

Our friend Mr. Crews crows over his a little, but at the same time manfully holds his piece—several of them in fact—and still has his cable peacefully doing duty, slightly disfigured perhaps but still in the swim.

The story points its own moral ☞ OKONITE TRADE MARK.

---

WE invite attention to the completeness of our *Electrical House Goods* stock. We claim to carry the largest line of any establishment in America, manufacturing many specialties and dealing only in the better grades of electrical merchandise.

If you are using BELLS, BATTERIES, ANNUNCIATORS, WIRE, PUSHES, GONGS or general supplies, *send us the order.*

Besides our own line of specialties we are the General Western Agents for

**Okonite Wires,**
**Interior Conduits,**
**Helios Arc Lamps,**
**Washington Carbons,**
**Lundell Fans,**
**Carpenter Enamel Rheostats,**
**Sechrist Automatic Switches.**

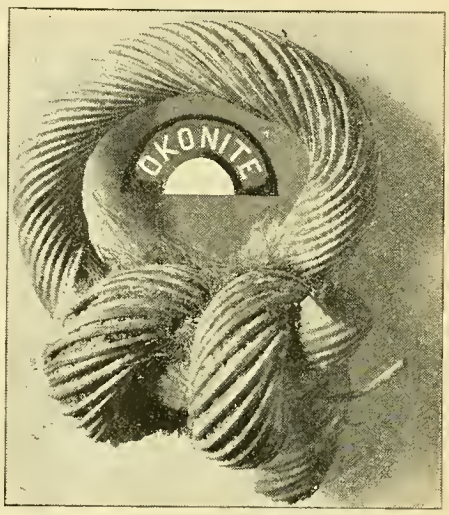

# A Badly Twisted Cable.

**A Story Which Seems to Prove That While an Okonite Cable May at Times Become very Knotty, in Fact Engage in an Occasional Snarl, It Never Neglects to Attend Strictly to Business.**

To the Editor of *Electrical Review:*

In compliance with your request, I will endeavor to give you an account of the tronble we had in Hampton Roads when the knot in the Okonite cable I recently sent you was made. The particular specimen sent you, and of which you have had an excellent cut made, was not much worse than some five or six others made at the same time.

In June, 1892, the Southern Bell Telephone and Telegraph Company laid a telephone cable in Hampton Roads, between Old Point Comfort and Willoughby Sand Spit (three miles), touching at Rip Raps, the old stone pile so familiar to every visitor to Fortress Monroe. The Rip Raps is just one mile off Old Point and two miles off Willoughby Spit, and is availed of as a test station for the cable.




The cable worked beautifully until the memorable freeze of January, 1893, when this section experienced the most protracted spell of severely cold weather felt in 40 years, to say nothing of the proverbial "oldest inhabitaut." Hampton Roads was gorged with ice from shore to shore, and between Old Point and Rip Raps (the channel) many vessels dragged their anchors for a week. The staunchest ships were helpless; they dragged anchors to and fro with the tide and ice. Vessels would go out half a mile and back again, and this see-sawing went on, with our cable right in the track of the anchors. The cable was broken the first day of the ice gorge. Further than that, the Old Point end had been pulled out and carried away. We knew nothing more as to the extent of the damage until the ice went out sufficiently (a week later) to enable us to reach Rip Raps, when we found the Rip Raps end still holding. We were provided with a commodious barge and strong tug boat alongside to handle it. We took aboard the Rip Raps end and reeled toward the other end of this piece of cable, which we found about 1,800 feet away. We now had 1,800 feet of cable safely reeled up and the rest of it at the bottom of the deep blue sea, but just where only Mr. McGinty could have answered. We proceeded to Old Point, tied up the barge and went to dragging with grapnels for the missing cable. We found piece after piece until we had four or five pieces, but this was not all, and drag as we would, we could find no more. We raked every foot of bottom within half a mile of where the cable had lain. A week or so after we had abandoned our search, and when getting ready for new cable to replace what was missing, a tug anchored just outside the limits of our "scratching," and when she wanted to leave, could not get her anchor at first, but finally succeeded in raising it to the surface, with the missing cable hanging on. The tug people slipped the cable, buoyed it and notified us. We recovered it the next day, and it was in this piece we found the puzzling knot sent you. We spliced up the pieces and with 600 feet of surplus cable we had in stock, relaid it and re-established service. We now had six splices in this cable, but it worked just as well as when first laid new, and has continued to do so, except for an interruption last November, when a ship's anchor broke it. This break was repaired next day, and to-day the cable is as well insulated as when first laid.

The mechanical injury to the armor of the cable was so severe at some places, that on cutting out the damaged section we were surprised to find the conductors in good condition, and the insulation unhurt. The conductors and insulation in the curious snarl of which you have had a cut made are perfect, notwithstanding the evident strain to which this piece of cable was subjected. Very truly yours, J. W. CREWS,

Norfolk, Va., June 4, 1894. MGR. NORFOLK TELEPHONE EXCHANGE.


BRANCHES:
Gate City Electric Co., Kansas City, Mo.
Southern Electrical Supply Co., St. Louis.

Central Electric Company,
173-175 Adams Street,
CHICAGO.

**Our stock of LUNDELL FAN MOTORS again replenished, ready for swift shipment.**

HILTON, HUGHES & CO.
*Broadway & 9th St.*
NEW YORK.

RETAIL OFFICE.

*New York, June 27th, 1894.*

*General Incandescent Arc Light Co.,*
*572-578 First Avenue, New York.*
*S. Bergmann, Esq., President.*

*Dear Sir:*

*We are pleased to testify to the entire satisfaction afforded us by the installation of your incandescent arc lamps, which you supplied for our establishment last year.*

*We hove about 500 of them in use throughout our entire building, and the lighting is beyond criticism. The lamps are also very sightly in appearance and make handsome fixtures. The light is absolutely steady and agreeable, and particularly well adapted to show off goods like ours.*

*Having now had the lamps for a sufficient length of time to feel every confidence that they will continue to give the same good service, we take pleasure in recommending them to be what you claim for them in all respects.*

*We also beg to express our appreciation of the promptness and ability with which you carried out your contract with us, which called for the installation of a larger number of lamps than had ever been grouped together in one building before in such a short time.*

*We feel that we could not have entrusted the work, which was at that time a matter of the greatest importance to us, to any other concern and experienced the same entire satisfaction.*

*Yours very truly,*
*Hilton, Hughes & Co*

Read this testimony about the largest installation of Low Tension Arc Lamps in one building in the world, and if you are still unconvinced of the superiority of our lamps, visit the great mercantile house that gave it to us and see for yourself. Then send for our prices and you will give us your future orders.

# GENERAL INCANDESCENT ARC LIGHT COMPANY,

NEW YORK.

169 Adams Street, CHICAGO.

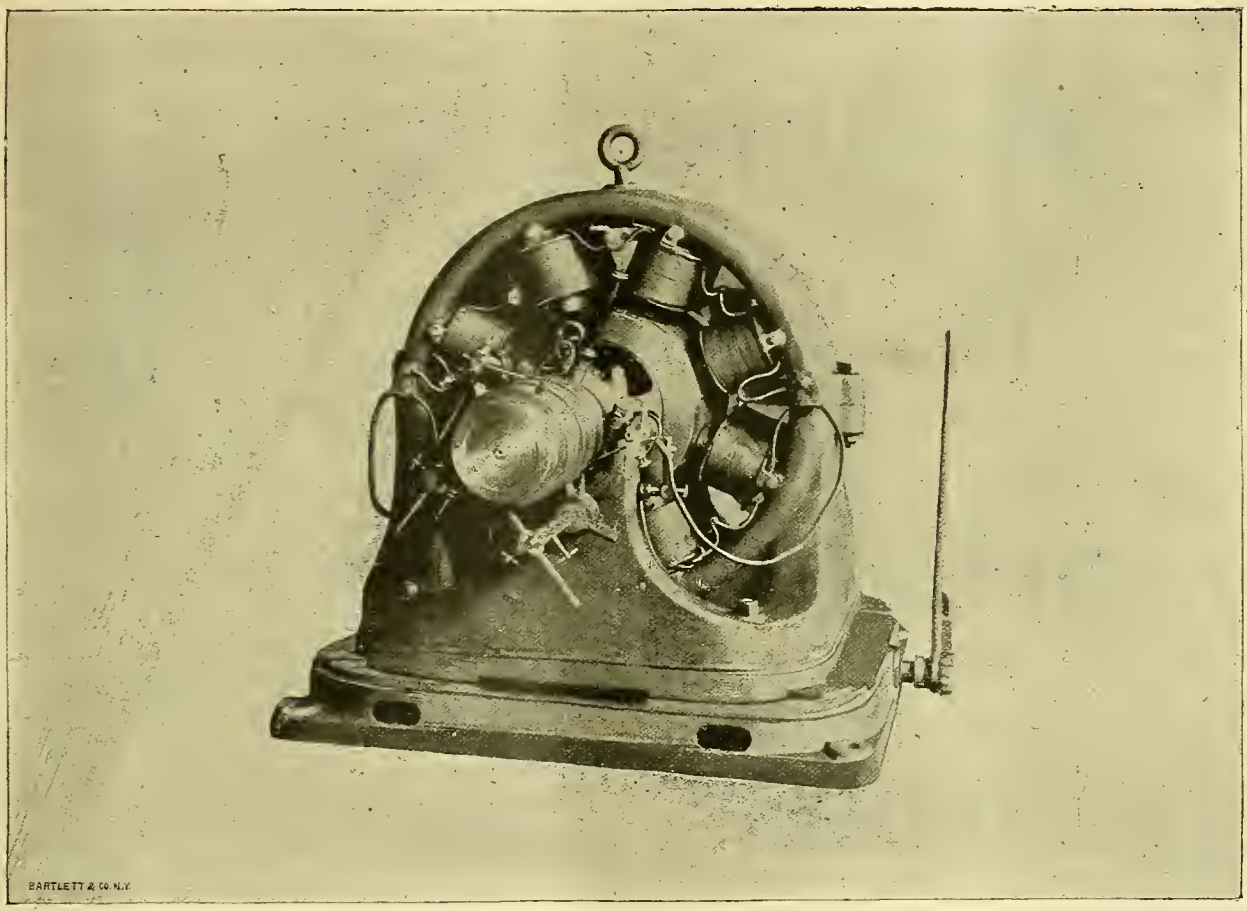
S. BERGMANN, President.

572 to 578 First Avenue, NEW YORK.

# Westinghouse Electric & Manufacturing Co.

**This Company, having the exclusive license to manufacture and sell multiphase motors and generators for long distance and other power transmission, under Nikola Tesla's numerous patents, has brought suits against the Thomson-Houston Company, the Redlands Company of California, the Granite State Electric Company of Concord, N. H. (all defended by the General Electric Company), and against the Stanley Laboratory Company, covering the form of apparatus manufactured by the Stanley Electric Manufacturing Company. These suits are being pressed with diligence so that there may be an early determination, which will enable us to promptly enforce our legal rights.**

**We offer a line of multiphase generators and motors unsurpassed in design and quality at such reasonable rates that there can be no occasion whatever for the use of apparatus made by unlicensed manufacturers.**




The World's Columbian Exposition was lighted by means of our multiphase generators, and the water-power of Niagara Falls will be transmitted by our multiphase generators in units of 5,000 horse power.

We have the best transformers at the lowest prices.

We offer 16 candle power stopper lamps, the best incandescent lamps ever made, at 25 cents each, with an allowance of 4 cents for each perfect bulb and stopper returned. Discount on large orders. A customer, in ordering more lamps, says: "Up to the present time not a stopper lamp has broken, and lots of them have burned over 1,400 hours." Send for illustrated catalogue.

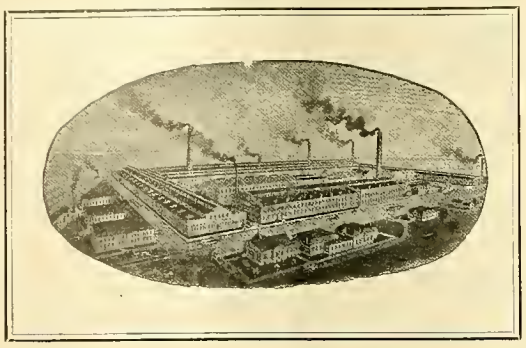
Our electric street railway equipments are recognized as the standard.

OFFICES IN ALL THE LEADING CITIES.

## WESTINGHOUSE ELECTRIC & MANUFACTUTING CO.,

PITTSBURGH, PA.

Electric Lighting and Power Apparatus.



The Brush Double Arc Lamp Patents sustained by repeated decisions of U. S. Courts.

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Agencies in all large cities.
The Russell & Officer Electrical Construction Co., Denver, Col.
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Office and Works, Cor. Belden and Mason Sts., CLEVELAND, OHIO.

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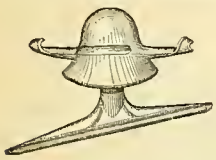
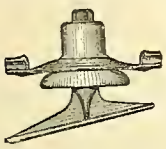


# MOULDED MICA



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*Hangers, Pull-Overs, Bracket Arm Insulators, Guard Wire, Feed Wire, Giant Strain and Section Insulators, Frogs, Crossings, Rail Bonds, Etc., Etc.*

**VULCABESTON** heat-proof Insulation for Magnet Spools, Bushings, Controller parts, Etc.

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# PROTECT YOUR MOTORS

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# HILL PATENT SELF-LOCKING STARTING SWITCH.

**No possible chance for an accident, as the Switch cannot be closed until the resistance is all in.**

**CHEAP. COMPACT. DURABLE.**

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Knoxville Electric Light and Power Co.

Knoxville, Ill., Feb 5 1894

Helios Electric Co
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Gentlemen, - Your inquiry in regard to the Helios arc lamp received, and in reply would say that we are using 26 of your lamps for street lighting purposes and they are giving very good satisfaction. The lamps we are using are your regular half arc lamps. There was a test made a few days ago by an expert, and he gave his opinion that the lamps were giving the rated candle power. We would recomend them to any one desiring to use a street lighting system and especially where coal is dear as it would be much more economical to use the Helios lamps from the incandescent machine than to use a separate arc machine.

Yours truly
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Electric Motors, Automatic or Hand Controlled.
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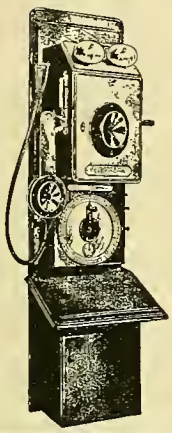
## The Harrison International Telephone Co



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WRITE AT ONCE.

**WHAT MONEY CAN EARN AND THE PEOPLE SAVE BY MEANS OF THE**

Harrison International Telephone.

**We either sell our telephones outright or lease them for a term of years.**

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Every Telephone Company in the United States is using Kerite Wire and Cables. Kerite is the Standard of High Grade Insulation, and will Cut Last and Out Class any other on the Market.

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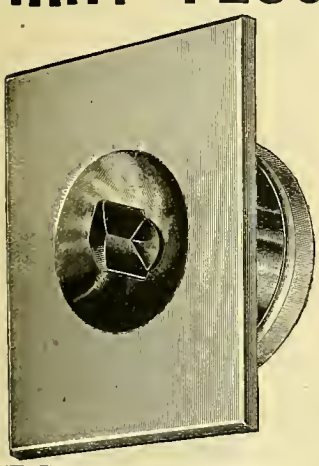

5 and 10 Ampere Single Pole.
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**The Only Snap Switch that has PROVEN A SUCCESS.**

**For Sale by All Supply Houses.**

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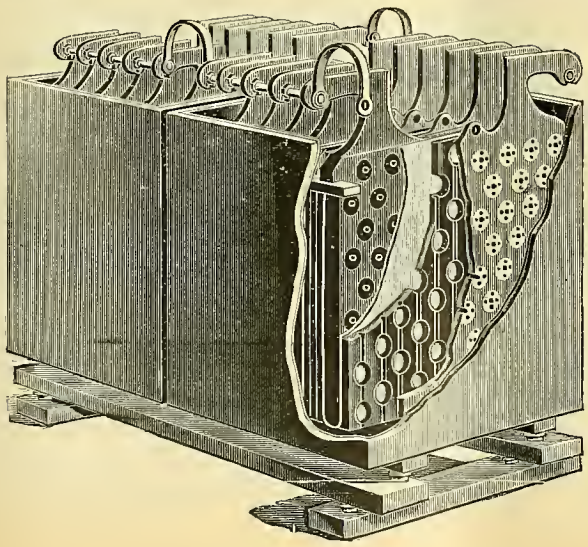

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***Cells from 10 to 5,000 amp. hours Capacity.***

Central Station and Traction Cells a Specialty.

BATTERIES FOR ISOLATED LIGHTING AND POWER PLANTS.

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And we have put ourselves in a position to fill this "**LONG FELT WANT.**" Do not fail to give us an opportunity to quote you on all orders for line material,

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Suitable for all Incandescent Dynamos, Plating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.

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HARD FLEXIBLE FIBRE IN SHEETS, RODS, AND TUBING.

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For Incandescent Dynamos, Plating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.

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For Electric Light, Telegraph and Telephone, Aerial, Underground and Submarine.

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# STREET LIGHTING FROM ALTERNATING CURRENT DYNAMOS.

**New Prices given on** **Lamps, Street Fixtures, Bank Boards,** **Series Sockets, Poles, Meters**

**And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.**

***This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.***

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***Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.***

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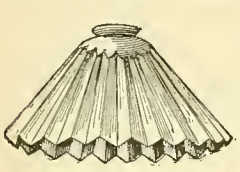
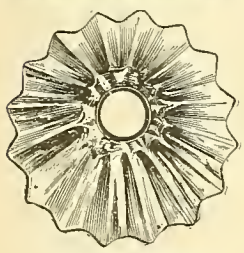
THEY ARE IN STOCK. SEND US A SAMPLE ORDER.





**Radial Fluted.**

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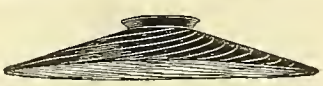
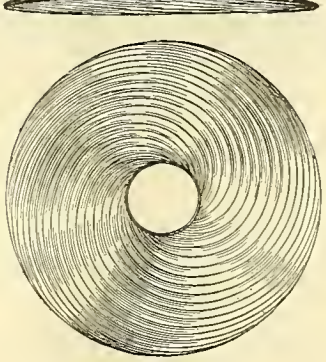
| 17 in. diameter, | 2¼ in. holder, | $ 9.00 |
| 8 " " | 2¾ " " | 10.00 |
| 0 " " | 2⅞ " " | 12.00 |





**Flat Spiral Corrugated.**

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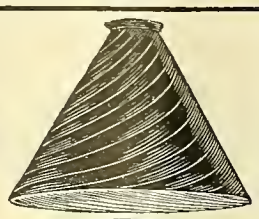
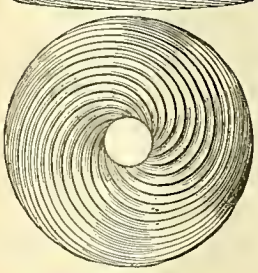
|---|---|---|
| 8 in. diameter, | 2¼ in. holder, | $ 8.00 |
| 10 " " | 2¾ " " | 9.00 |





**Deep Spiral Corrugated.**

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| 7 in. diameter, | 2¼ in. holder, | $ 8.00 |
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Enameled Green Outside, Silvered Inside.

The simplest, cheapest and best Reflectors for increasing candle power of incandescent lamps.

Made in all staple sizes of electric shades.

Always bright; cannot tarnish.

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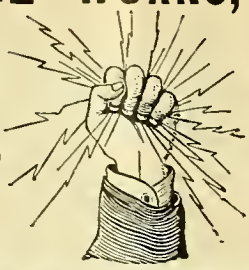
Incandescent and Flexible Cords,

AMERICANITE. MAGNET. OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



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The points or teats on the lower rim of the petticoat attracts the water on the outer surface of the insulator into drops. The water drops from these points on to the cross-arm, thereby preventing the moisture from creeping up on the inner petticoat, and thence to the pin. Owing to the great success of our Patent Teat Insulator in Telegraph Work, where the efficiency of the Insulator has proven to be more than twice that of the ordinary Insulator, we have concluded to apply the device to all Insulators for Telegraph, Telephone and Street Railway Work.

**Standard Screw Glass Insulators, Floor Insulators, Glass Break Knobs, Battery Jars, Arc Light Globes for all Systems. Colored Glass Insulators to designate different currents**

**WORK ON SPECIAL DESIGNS A FEATURE.**

Send Model or Drawing and we will furnish estimates.

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For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

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**GREAT WESTERN MFG. CO.,**

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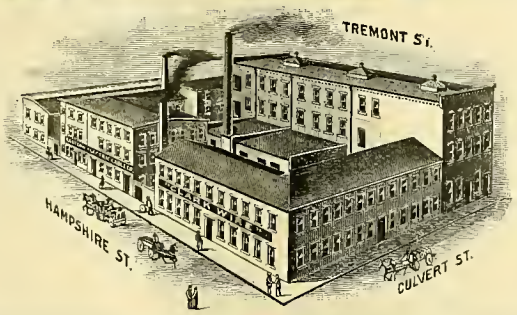


**In a Letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A Thoroughly Reliable and Desirable Wire in every respect."**

The Rubber used in insulating our Wires and Cables is especially chemically prepared, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat.

We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first class Insulated Wire.

We shall be pleased to mail Catalogues with Terms and Discounts for Quantities.

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61 and 63 Hampshire St., Boston, Mass.

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Manufacturers of all kinds of

OPEN AND CLOSED CIRCUIT CELLS,

And Dealers in

Everything in the Battery Line.

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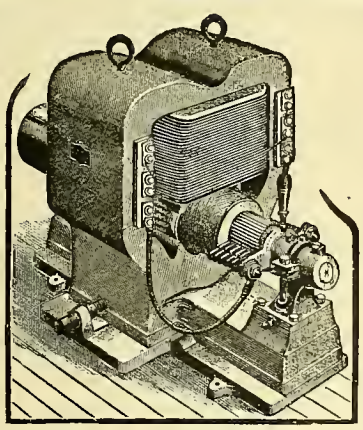
M. M. HAYDEN, President and Manager.



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**Muncie Steel Magnet**

**Motors and Dynamos.**

**1 to 50 Horse Power Motors. 18 to 700 Lights' Capacity Dynamos.**

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ALL KINDS PRICES OF PARTS Dynamos and Motors AND PARTS OF SAME TELEPHONES ELECTRICAL SUPPLIES

SEND STAMP FOR CATALOGUE PALMER BROS. MANUS, CONN.

THE

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J. B. WEIS,

**Analytical and Consulting Chemist**

AND ASSAYER,

*Room 42, 81 Clark Street.*

☞Prices on application.

**Certificate of Analysis, No. 918.** Chicago, March 9, 1894.

**This Certifies** that I have analyzed sample of Sal Ammoniac, marked "A. G. Sal Ammoniac," submitted by Western Electric Company.

I find the amount of:

| | | | | | |
|---|---|---|---|---|---|
| Ammonium Chloride | contained | therein | to be | 99.51 | per cent. |
| Ammonium Sulphate | " | " | " | 0.03 | " |
| Moisture | " | " | " | 0.13 | " |
| Non-Volatile Matter | " | " | " | 0.02 | " |
| Organic Matter | " | " | " | 0.31 | " |

The Non-Volatile Matter consists of Iron Oxide and Alumina.

Signed, J. B. WEIS.

# WESTERN ELECTRIC CO., CHICAGO.

# Chicago General Fixture Co.,

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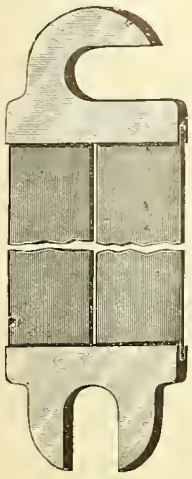

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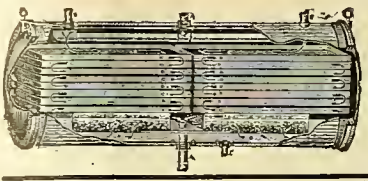

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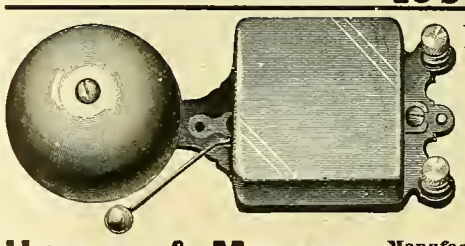

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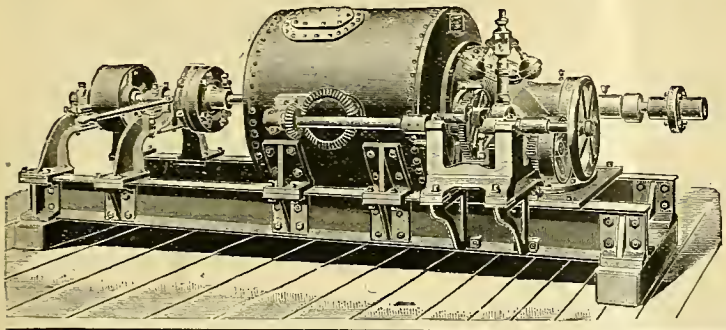

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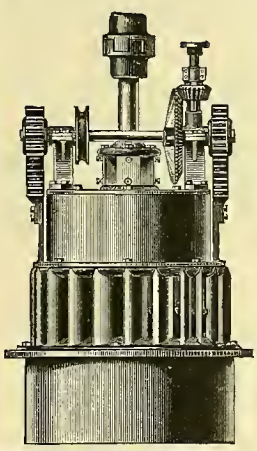

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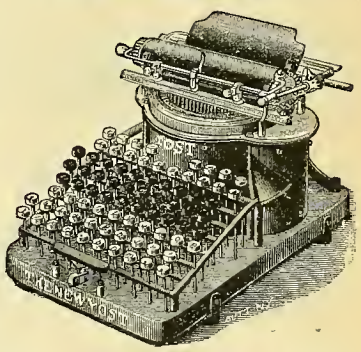


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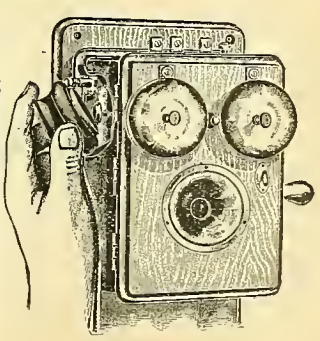

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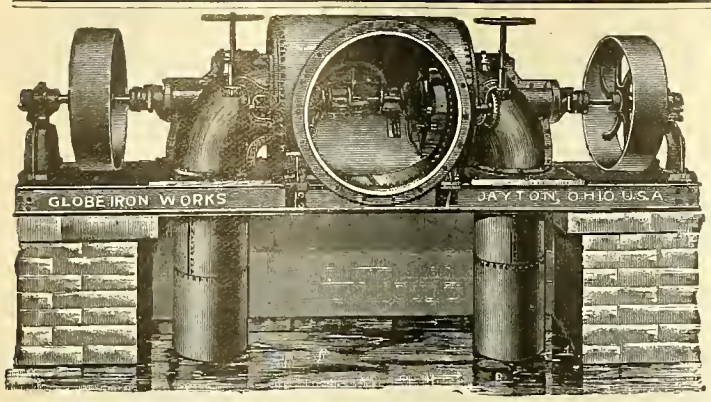


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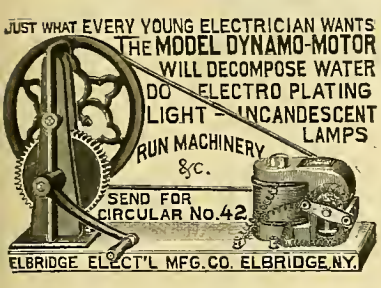


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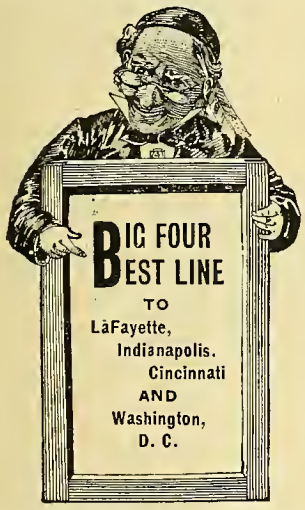


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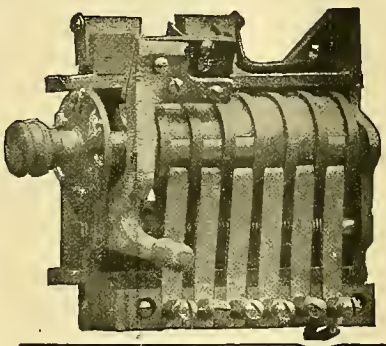

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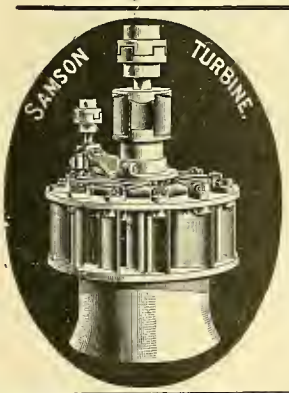


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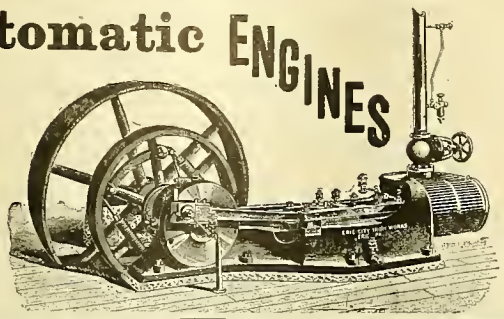

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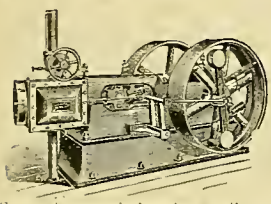

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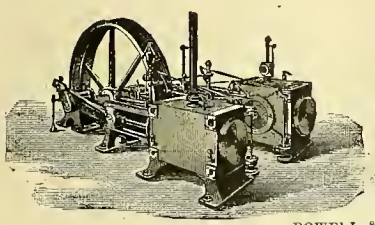

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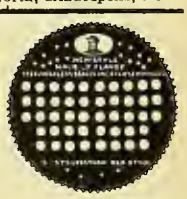

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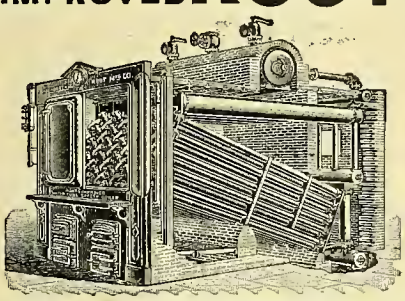

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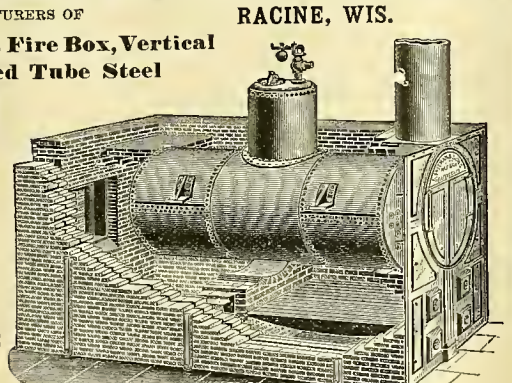

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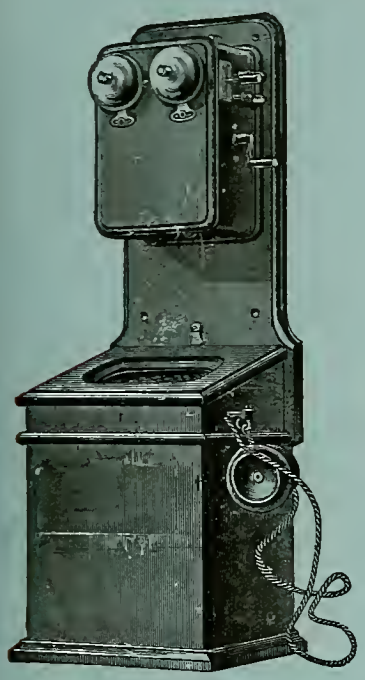

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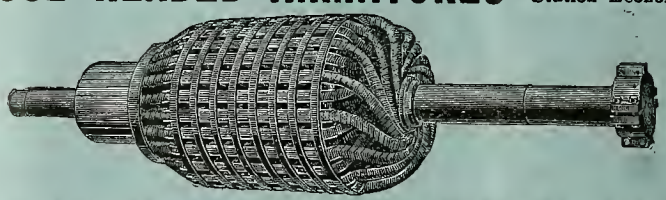

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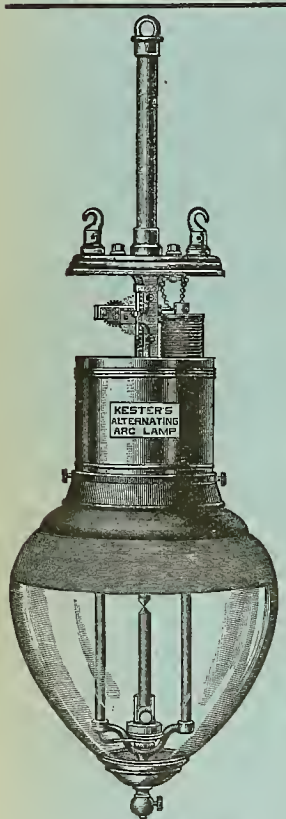


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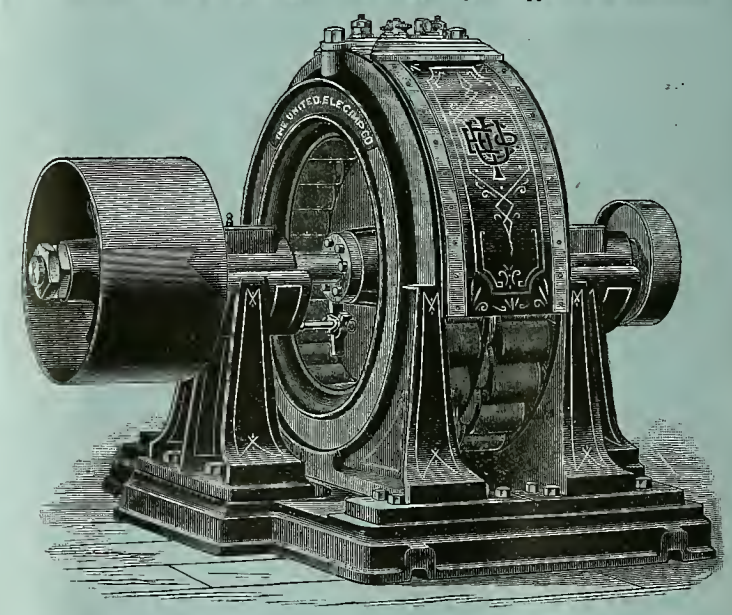


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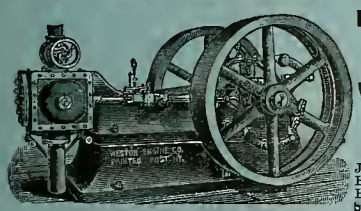

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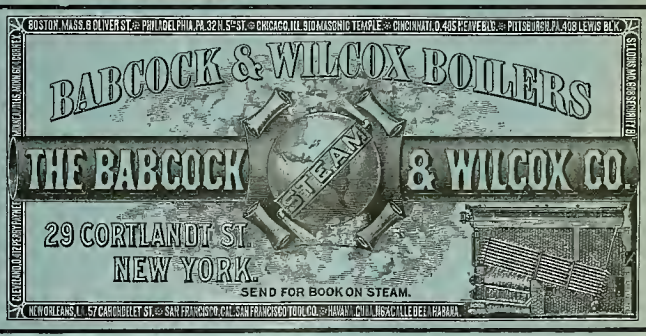


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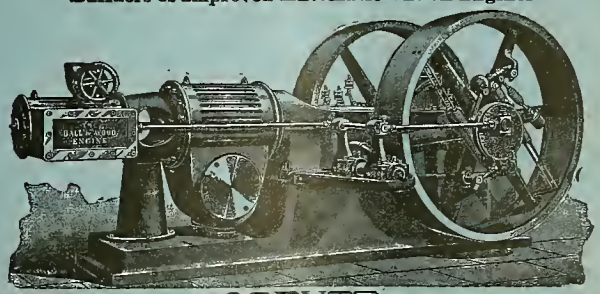

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Electric Storage Battery Co
Porter & Buerdorf.

**Adjusters, Lamp**
Dow Adjuster Co.

**Annunciators.**
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co.. The.
La Roche Electric Wks.
Little. F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Central Electric Co.
Electric Appliance Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hemingray Glass Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Central Electric Co.
Electric Applisnce Co.
Greeley & Co., The E.S.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co.. W. R.
Washington Electric Co.
Western Electric Co.

**Belting.**
Shultz Belting Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co., The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Fulton Steam Boiler Wks.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electrician Publishing Co.

**Brushes.**
Partridge Carbon Co.
Wirt, Chas.

**Burglar Alarms.**
Central Electric Co.
Electric Appliance Co.
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Metropolitan Electric Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric.** (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Chicago Ins. Wire Co.
Crescent Ins. Wire & Cable Co.
Cushing & Morse.
Eastern Electric Cable Co.
General Electric Co.
Hill, W. S. Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Rafferty & Co., T. C.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons Points & Plates.**
Central Electric Co.
General Electric Co.
Metropolitan Elecrict Co.
Partridge Carbon Co.
Western Electric Co.

**Car-Heaters, Electric.**
Consolidated Car-Heating Co.

**Conduits**
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Hussey Co.
Amstutz, N. S.
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Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Muncie Elec. Mfg. Co.
Osburn, Harry G.
Washington Electric Co.
Wirt, Chas.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
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Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Ft Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Osburn, Harry G.
Roberts & Co., E. P.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Hunnell & Co , J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Chicago Ins. Wire Co.
Crescent Ins. Wire & Csble Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Ind. Rub. & Ins. Wire Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co.. The.
Phillips Insulated Wire Co.
Rafferty & Co., T. C.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Electric Appliance Co.
Hubley Mfg. Co.
Metropolitan Electric Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Hubley Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Sioux City Brass Works.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Electric Railways.**
Brush Electric Co
General Electric Co.
Hubley Mfg. Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Cameron & Gillett.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Osburn, Harry G.
Roberts & Co., E. P.
Rushmore, S. W.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Metropolitan Electric Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Weston Engine Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Central Electric Co.
Crescent Electric Co.
Diehl & Co.
Muncie Elec. Mfg Co.

**Fibre**
American Hard Fibre Co.
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.

**Gears.**
Grant, Geo. B.

**General Elec. Supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Crescent Electric Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
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Hubley Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Porter & Buerdorf.
Rafferty & Co., T. C. -
Sioux City Brass Works.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason E. P. Mfg. Co.
Hemingray Glass Co.
Hubley Mfg. Co.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.
Hubley Mfg. Co.

**Hard Rubber Goods.**
American Hard Fibre Co.
Butler Hard Rubber Co.

**Insulators and Insulating Materials.**
American Hard Fibre Co.
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Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
Hemingray Glass Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Ind. Rub. & Ins. Wire Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
National India Rubber Co.
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Bunnell & Co., J. H.
Central Electric Co.
Chicago Ins. Wire Co.
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Cushing & Morse.
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Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
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Buckeye Electric Co.
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Ft. Wayne Elec. Corporation.
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Matner Electric Co.
Metropolitan Electric Co.
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Westinghouse Elec. & Mfg. Co.

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Phosphor Bronze Sm.Co. Ltd

**Platinum.**
Baker & Co.

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Morris, Tasker & Co.

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Phœnix Glass Co.

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**Push Buttons.**
Central Electric Co.
Electric Appliance Co
Huebel & Manger.
Metropolitan Electric Co.

**Rheostats.**
General Electric Co.
Rushmore, S. W.

**Sal Ammoniac**
Hayden-Booker Mfg. Co.
Johns & Co.
Klipstein, A. & Co.
Law Battery Co.

**Second-Hand Electrical Machinery.**
Gregory, Chas. E. Co.
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Boston Braid Mfg. Co.

**Slate.**
Independent Electric Co.

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Porter & Buerdorf.

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Cushing & Morse.
Chicago Ins. Wire Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips insulated Wire Co.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
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Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Western Electric Co.

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Harrison Int. Telephone Co.
National Tele. Mfg. Co.
Western Electric Co.
Western Tel. Const. Co.

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Royal Electric Co.
Stanley Electric Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

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Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

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Cor. School of Mechanics.
Correspondence School of Technology.
Scientific Machinist Co.

**Varnishes.**
Standard Paint Co.

**Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

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# THE SIMPLEX ELECTRICAL Co.

BOSTON, 75-81 Cornhill.

**Manufacturers of High Grade Wires and Cables.**

**Simplex T. Z. R. Weatherproof Wires.**
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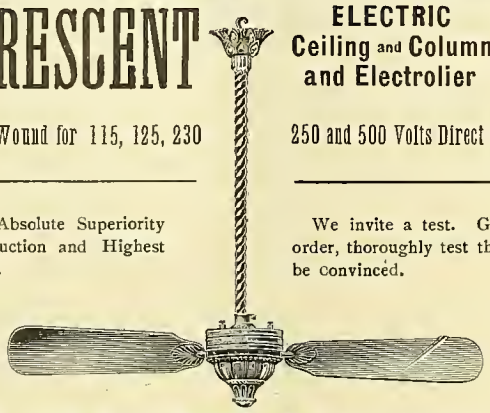
Are Wound for 115, 125, 230 250 and 500 Volts Direct Current.

We claim Absolute Superiority of Construction and Highest Efficiency.

We invite a test. Give us a sample order, thoroughly test the Crescent, and be convinced.



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Manufacturers of Electrical Specialties,
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NO BELTS. NO SHAFTING.

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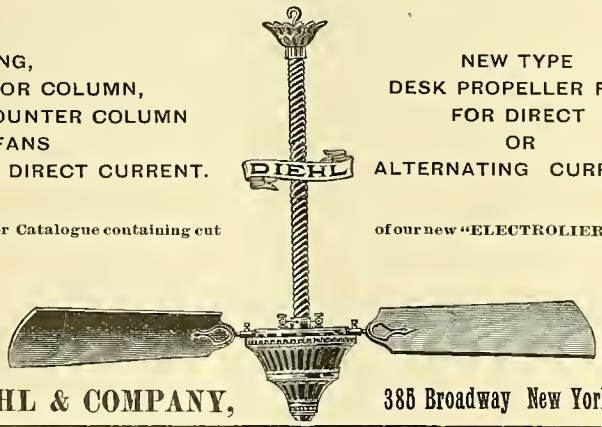
Send for Catalogue containing cut of our new "ELECTROLIER" FAN.

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## THE HELIOS LAMP FOR STREET LIGHTING.

A. L. WARFEL, President. C. F. FOOTE, Vice President W. H. MOOREHOUSE, Secretary.

Knoxville Electric Light and Power Co.

Knoxville, Ill., Feb 5 1894

Helios Electric Co
Philadelphia Pa

Gentlemen,- Your inquiry in regard to the Helios Arc lamps received, and in reply would say that we are using 26 of your lamps for street lighting purposes and they are giving very good satisfaction. The lamps we are using are your regular half arc lamps. There was a test made a few days ago by an expert, and he gave his opinion that the lamps were giving the rated candle power. We would recomend them to any one desiring to use a street lighting system and especially where coal is dear as it would be much more economical to use the Helios lamps from the incandescent machine than to use a separate arc machine.

Yours Truly
Knoxville Elec Lt & P Co.

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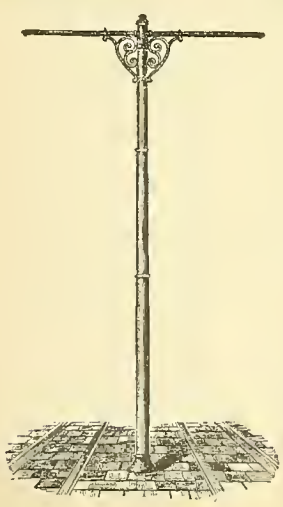
1821. 1888.



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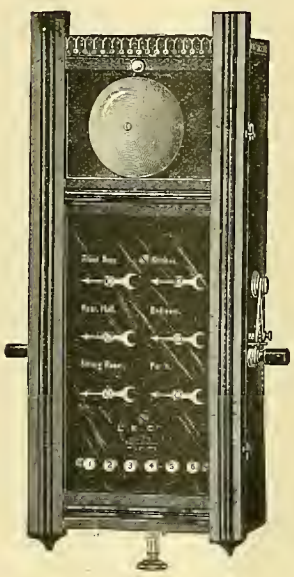

We are prepared to supply complete equipments for the installation of

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Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
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## WIRE AND CABLES.

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# The Harrison International Telephone Co.

AGENTS' TERRITORIES NOW BEING ALLOTTED.

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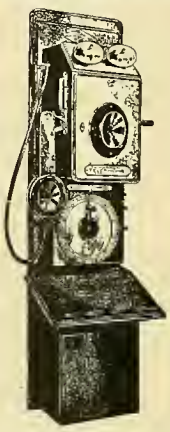

WHAT MONEY CAN EARN AND THE PEOPLE SAVE BY MEANS OF THE

## Harrison International Telephone.

**We either sell our telephones outright or lease them for a term of years.**

This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Pateot No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete electric speeking telephone operated by battery; and owos Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an autometic switchboerd. Our patents embrace every device necessary in the coostruction of a telephone plant with either mannal or automatic switchboerd.

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# We Want Western Business.

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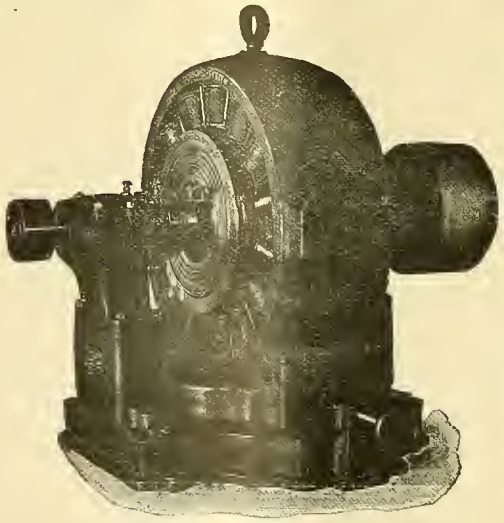
MANUFACTURED IN SIZES FROM

*25 to 5,000 Lights,*

SINGLE OR MULTIPHASE.

Direct Connected Dynamos.

Direct Current Generators.



1,000 Light Alternator.

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## FORT WAYNE, IND.,

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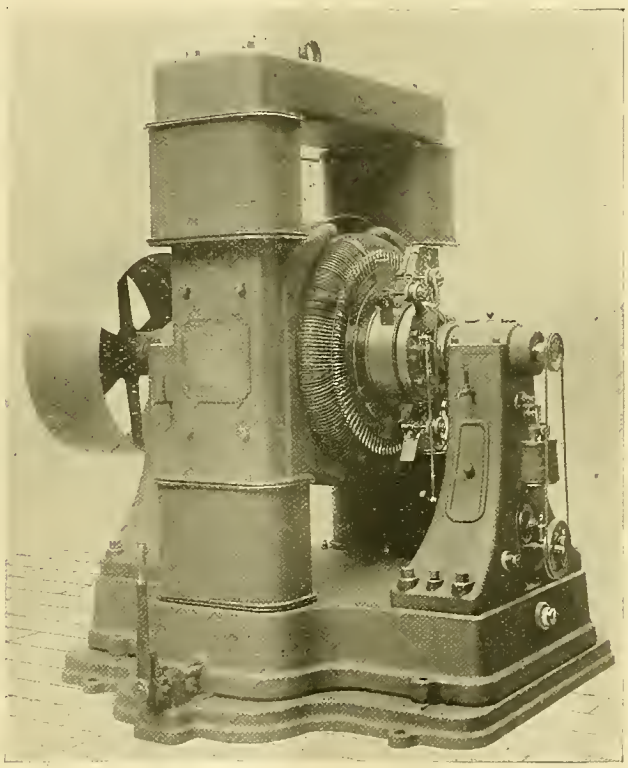
Under the PATENTS OF JAMES J. WOOD.

**LOW PERIOD DIRECT CONNECTED ALTERNATORS.**



**Complete Apparatus for Arc, Direct Current Incandescent and Alternating Incandescent Lighting also for Power Transmission either by Direct or Alternating Currents.**

The New Wood Arc Dynamo, No. 10; Capacity 125, 2000 c. p. Lamps.

## ARC LAMPS for Constant Potential, Alternating or Railway Circuits.

The new "WOOD" Transformers have the highest Efficiency and Best Regulation of any yet produced. They are easy to install, light weight and very handsome in appearance.

Parties requiring Transformers would do well to get our estimates before purchasing.

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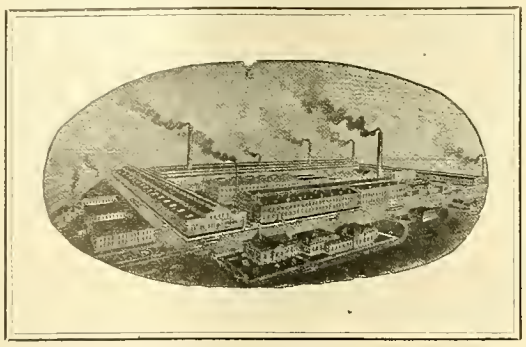
Electric Lighting and Power Apparatus.



The Brush Double Arc Lamp Patents sustained by repeated decisions of U. S. Courts.

THE

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Agencies in all large cities.
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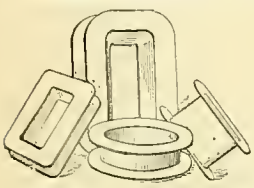

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MAGNET SPOOLS, BUSHINGS, COMMUTATOR RINGS, WASHERS, CONTROLLER PARTS, INSULATING SHEETS, ETC.

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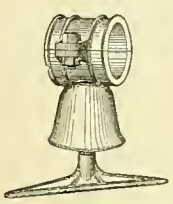

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# PROTECT YOUR MOTORS

BY USING THE

## HILL PATENT SELF-LOCKING STARTING SWITCH.

**No possible chance for an accident, as the Switch cannot be closed until the resistance is all in.**

**CHEAP. COMPACT. DURABLE.**

MADE ONLY BY THE

## W. S. Hill Electric Co.,

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SEND FOR CIRCULAR AND PRICE LIST.

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THE

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## HORNBERGER ELECTRIC MFG. CO.,

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# WESTINGHOUSE CONVERTERS.

20 Lights, $20.00—10 per cent. off if 100 Lights are ordered.
30 " 30.00—15 " " " 250 " " "
40 " 40.00—20 " " " 500 " " "

## SLATTERY

| Converters: | | Meters: | | |
|---|---|---|---|---|
| 5 Lights, | $ 8 00 | 10 Lights, | 10 Amperes, | $10 00 |
| 10 and 15 " | 12 50 | 15 " | 15 " | 12.50 |
| 25 " | 18 50 | 25 " | 25 " | 15.00 |
| 40 " | 20.00 | | | |
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**911-913 Olive St., ST. LOUIS, MO.**

GENERAL ELECTRICAL SUPPLIES.

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**TROLLEY WHEELS,** Bronze, Brass or Iron, patent graphite bearings, a ***10,000 mile record***—Still running.

**TROLLEY HARPS,** Brass, Bronze, Malleable Iron or Steel. Light, strong, new design. Cheapest and best on the market.

**BEARINGS** For Dynamos and Motors. We guarantee 20 per cent. more life than any anti-friction metal offered for sale.

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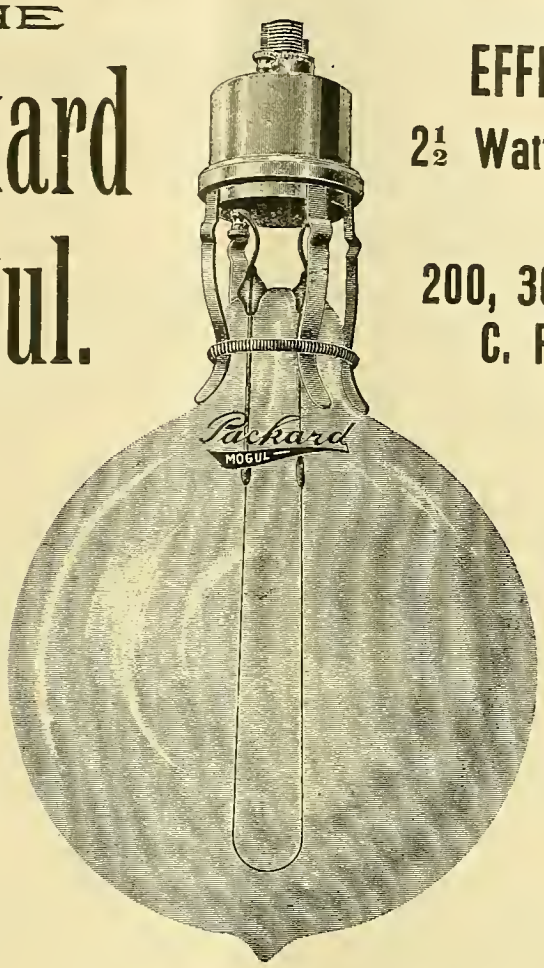
WIRES AND CABLES

THE

## Packard Mogul.




**EFFICIENCY:**
**2½ Watts per C. P.**

**200, 300 and 500 C. P. Sizes.**

Superior to the Arc Lamp for all Interior Lighting.

The Coming Method of Street Lighting with Alternating Current.

## NOTE THESE POINTS:

**The saving in current pays for renewale.**
**One-third more light with the same energy.**
**Reduced cost of wirlng.**
**Clear, steady, pleasant light without shadows.**
**No carbon dust. No trimming.**
**No special transformer required.**

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Paranite Wires and Cables, "O. K." Weatherproof Wires and Cables.

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PACKARD ELECTRIC COMPANY, Warren, Ohio,

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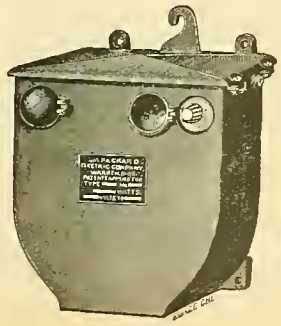

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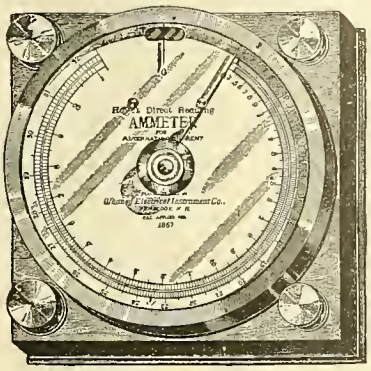
The **Hoyt Standard Ammeters** and **Voltmeters** for **Lamp** and **Meter** measurement on **Alternating Currents** are now ready for the market.

Send for our **1894 Catalogue** which contains the above and other new instruments of our manufacture.




## Whitney Electrical Instrument Co.,

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Factories: Penacook, N. H.; Sherbrooke, P. Q., Can.

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Suitable for all Incandescent Dynamos, Plating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.

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AGGREGATING IN CAPACITY **260,425 Horse Power,** ARE NOW IN USE.

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"NATIONAL" COMPOUND RECEIVER.

## THE "NATIONAL."

We make simply a business proposition. Buy two sets of our instruments and make your own tests. If satisfactory the way is open for more business, either in telephones or switchboards for exchanges.

**Our head telephones are largely used by Bell telephone operators.**

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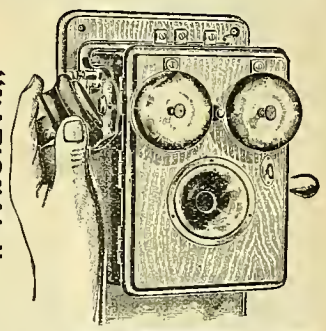
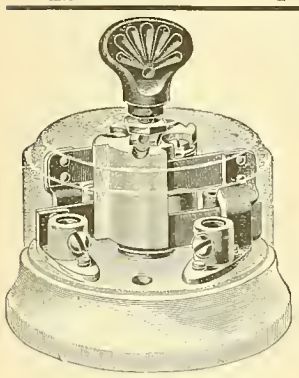


"NATIONAL." Method of Placing Receiver in Holder.



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**DOUBLE POLE**

## SNAP SWITCH,

MADE BY THE

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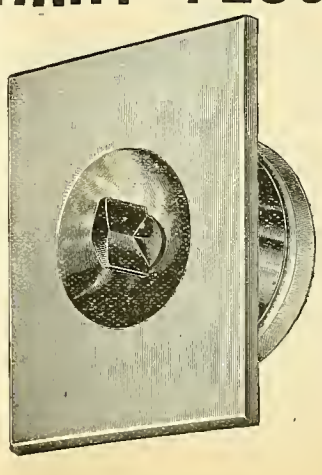
THOS. G. GRIER, EDWARD R. GRIER, Western Representatives.

**Factory: Bridgeport, Conn.**

*Sockets, Switches, Cut Outs, and Electrical Specialties. Good Goods and Prompt Shipments.*

## HART FLUSH SWITCHES.



5 and 10 Ampere Single Pole.
10 Ampere Double Pole.
10 Ampere Three-way.

**The Only Snap Switch that has**

**PROVEN A SUCCESS.**

**For Sale by All Supply Houses.**

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EUGENE F. PHILLIPS, Prest. W. A. HATHAWAY, Treas. W. H. SAWYER, Sec'y.

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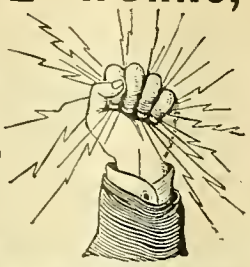
RAILWAY FEEDER AND TROLLEY WIRE,

ELECTRIC LIGHT LINE WIRE,

Incandescent and Flexible Cords,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



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MONTREAL BRANCH, Eugene F. Phillips' Electrical Works

## W. U. Double Petticoat Teat Insulator.

The points or teats on the lower rim of the petticoat attracts the water on the outer surface of the insulator into drops. The water drops from these points on to the cross-arm, thereby preventing the moisture from creeping up on the inner petticoat, and thence to the pin. Owing to the great success of our Patent Teat Insulator in Telegraph Work, where the efficiency of the Insulator has proven to be more than twice that of the ordinary Insulator, we have concluded to apply the device to all Insulators for Telegraph, Telephone and Street Railway Work.

**Standard Screw Glass Insulators, Floor Insulators, Glass Break Knobs, Battery Jars, Arc Light Globes for all Systems, Colored Glass Insulators to designate different currents**

**WORK ON SPECIAL DESIGNS A FEATURE.**

Send Model or Drawing and we will furnish estimates.

**HEMINGRAY GLASS CO.,**

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# "CLARK" WIRE.

TRADE MARK.

For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

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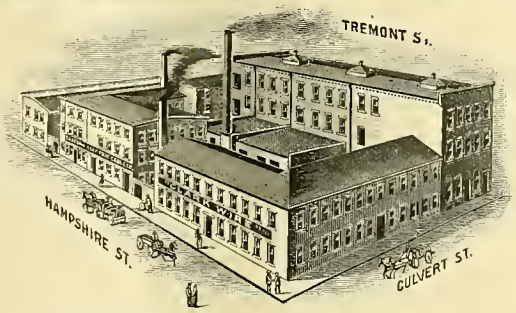


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We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first class Insulated Wire.

We shall be pleased to mail Catalogues with Terms and Discounts for Quantities.

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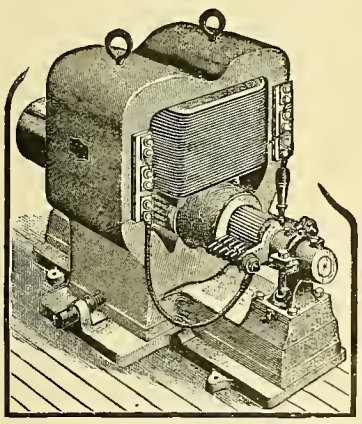

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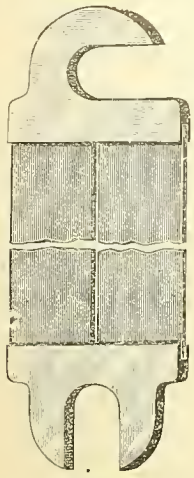

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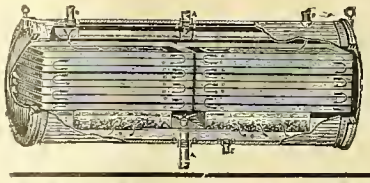

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A competent young man desires a position with an electric light or power company as general electrician. Can take complete charge of all electrical machinery and do all necessary station, repair and line work. An uprising city in the south or west preferred. Have last been with the Edison General Electric Co. Correspondence with reliable parties solicited.
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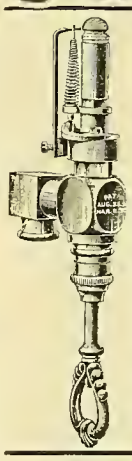

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Which always indicates whether the gas is on or off. Safe, reliable; will not fail to light; have interchangeable stems; are adaptable to any fixtures, and fully guaranteed. Made in 5 styles but all on the same general principle as style shown. Candle, Billiard, Argand. Our **Victor** with side lever, is a little wonder.
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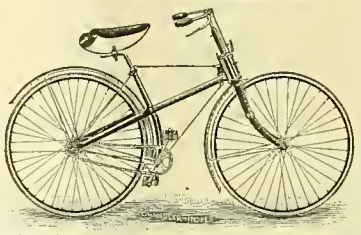
With 2-inch Morgan & Wright Pneumatic Tires.



30-inch wheel; 53-inch gear; swivel head; first class adjustment; ball bearing of most approved pattern on both wheels; crank shaft and pedals highly finished; first class in every particular. Price, $45.00 Terms, 60 days net or 5% discount for cash; or, if $5.00 accompanies the order, to insure freight, we will ship C. O. D., making a cash discount of 10% in place of 5%, giving you the privilege of examining the wheel before paying the agent.
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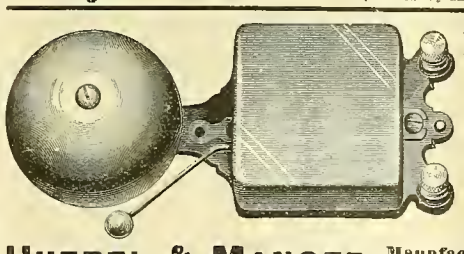

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Highly Important to Telephone Users.

**BEWARE OF INFRINGING!**

The D'Unger Long Distance Telephone (the "Far-Away Talker") can now be had for use in Telephone Exchanges on a small annual royalty, and **on no other terms**. It is constructed under numerous patents, especially **Patent No. 390,575**, granted Oct. 2, 1888, which is not only the **first**, but **the only undisputed and indisputable valid patent granted for an All-Carbon Multiple-Contact Microphonic Telephone Transmitter.** All all-carbon multiple-contact telephone transmitters built without or under patents granted since Oct. 2, 1888, are **infringements upon Patent No. 390,575**—a fact to be borne in mind by persons contemplating the use of Telephones.
The "D'Unger" is the only self-cleaning telephone in the world. It sends speech one (1) mile or five thousand (5,000) miles in a perfectly clear manner; can be operated at half the ordinary expense; is always in order, and has for its Receiver a Patent Compound Magneto, making but **one magnetic field** It has likewise Paul D'Unger's Patent Diaphragm Regulator, which prevents the words from running together. As a whole it is complete, cannot be surpassed, and has no equal. Pronounced by all unprejudiced electricians to be the **Peer of Telephones.** Address
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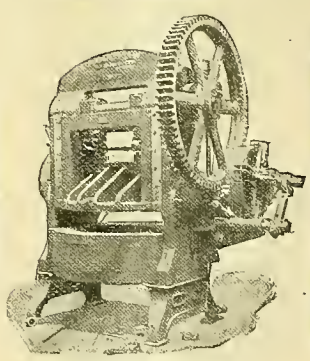

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This Press is Designed for
## Cutting Armature Discs,
**Punches, Shears, Drop Hammers, Dies, Etc., For Electrical Work.**
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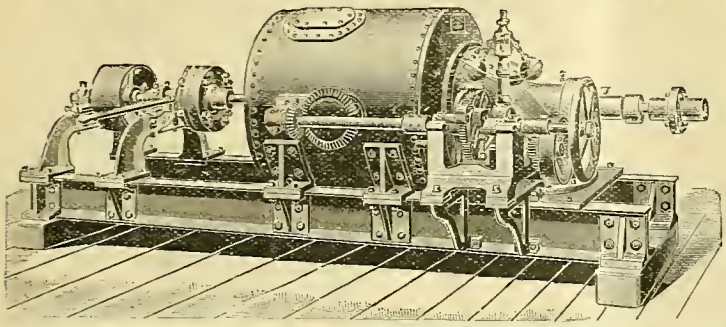
# VICTOR TURBINE WATER WHEEL.



Cylinder or Register Gate—Close Regulation and High Efficiency at Full and Partial Gate.

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter**, being **double the power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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The accompanying engraving represents a single 10-inch Victor Turbine on horizontal shaft to develop 36 H. P. under 38 feet head. Arranged with 12-inch Worrell Friction Coupling at one end to disconnect pulley.

We are now prepared to furnish Victor Turbines, either single or in pairs, on horizontal shafts, and where the situation admits of their use we recommend them.

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**WE DO NOT DENY,**

Costs a little more than some other open circuit cells at the start, but owing to its great HOLDING-UP POWER and Uniformity of Current it eventually is the cheapest. As we manufacture various other types of open circuit cells we must be honest in asserting this.

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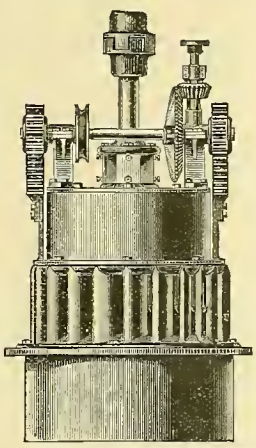

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On Vertical or Horizontal Shaft,
Especially Adapted for Electric Work.

**Gives more power as to diameter with a higher percentage of useful effect than any other water-wheel heretofore made.** All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with me, **as I am willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

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Estimates furnished for complete power plants and results guaranteed.

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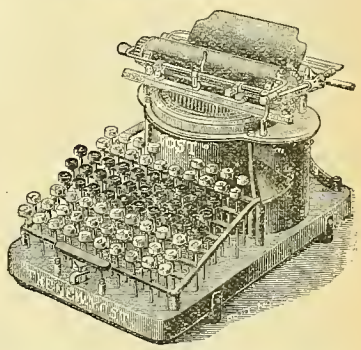

Constructed on principles radically its own, insuring results always sought for but absolutely unattainable in the construction of any other machine. It is pre-eminently the telegrapher's and professional stenographer's typewriter.

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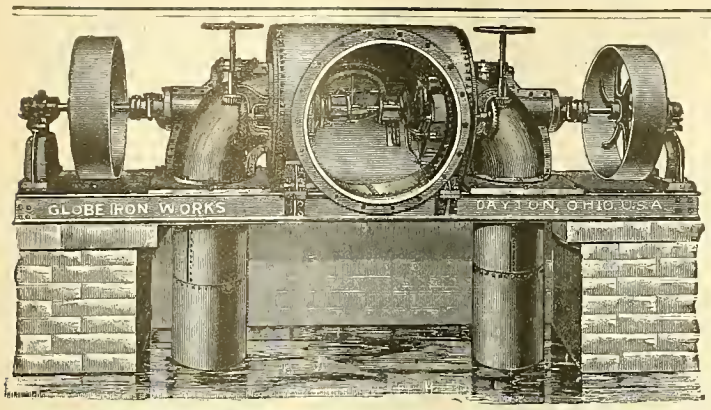


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We sell the finest Vermont Slate, and finish in

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It talks as well over one hundred miles as any other Telephone talks over one mile.

This company is also prepared to fully equip Telephone exchanges, (furnishing everything from the telephone to the wire and poles). Private lines, Factory plants, etc., and do all kinds of construction work.

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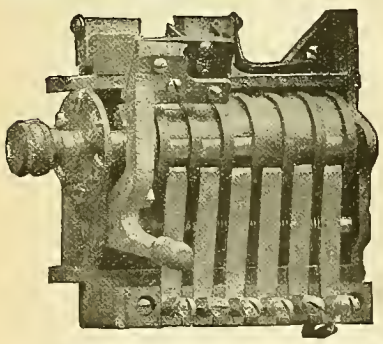

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A New Book Just Published.

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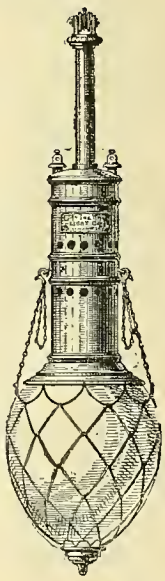

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**Complete Station Equipments.**

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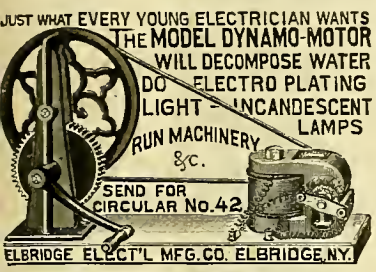


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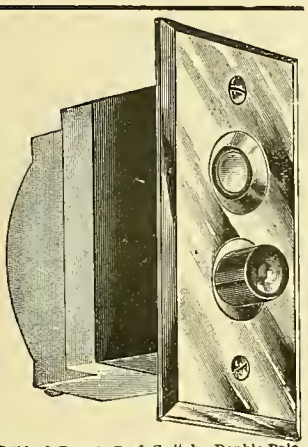

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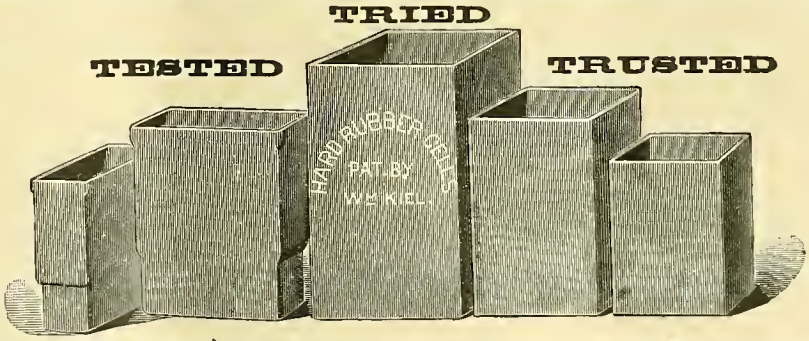


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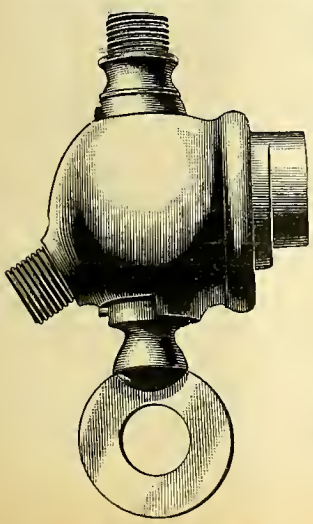

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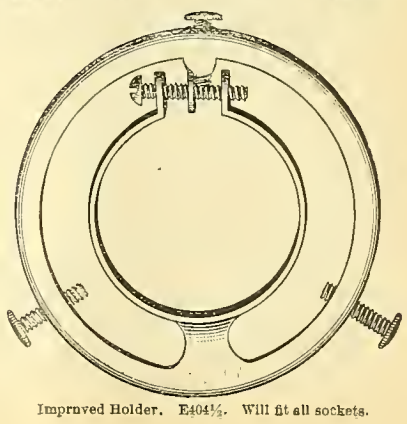

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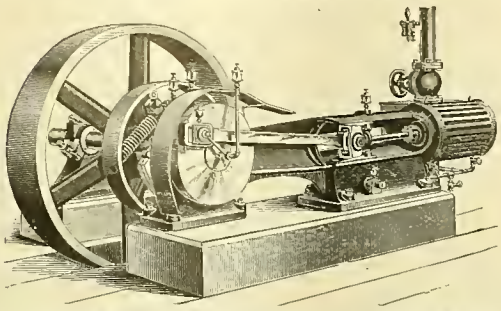

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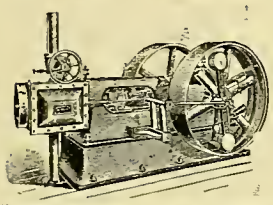

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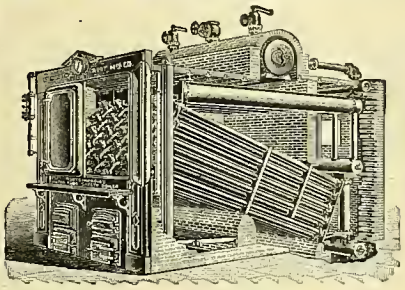

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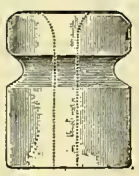

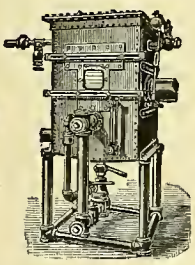

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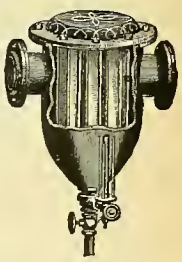

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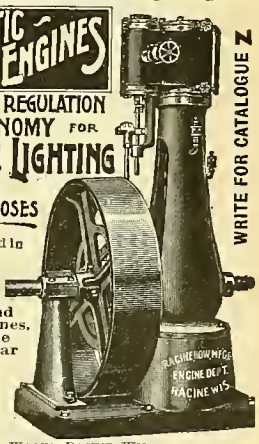

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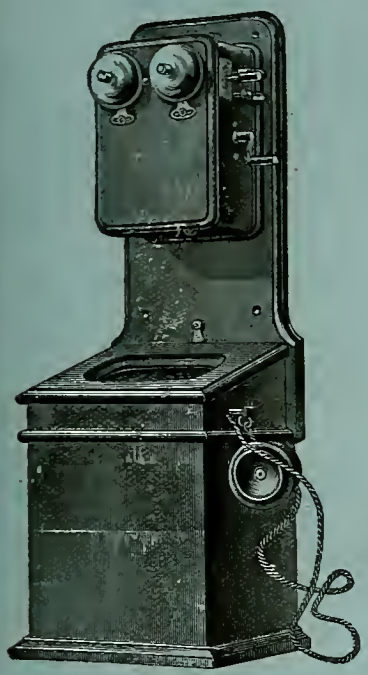

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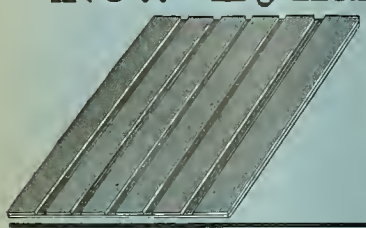

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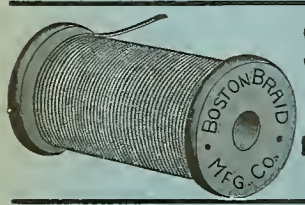


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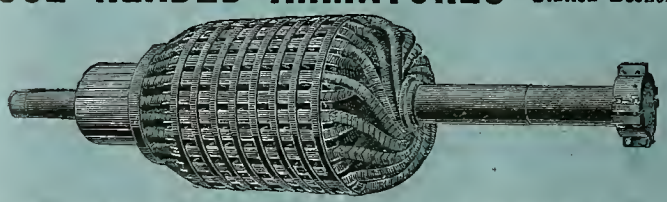

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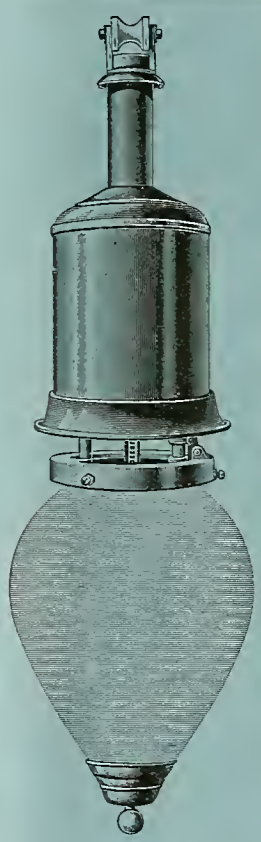

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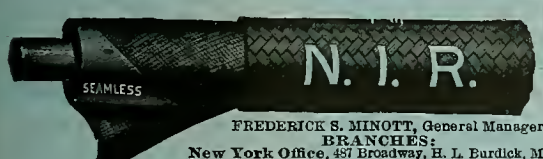


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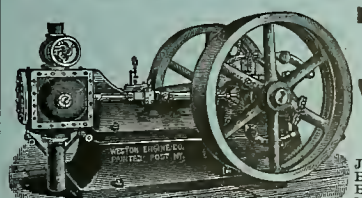

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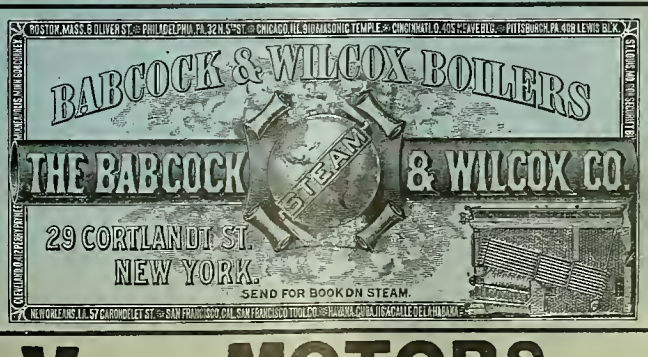


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**Manufacturers of High Grade Wires and Cables.**

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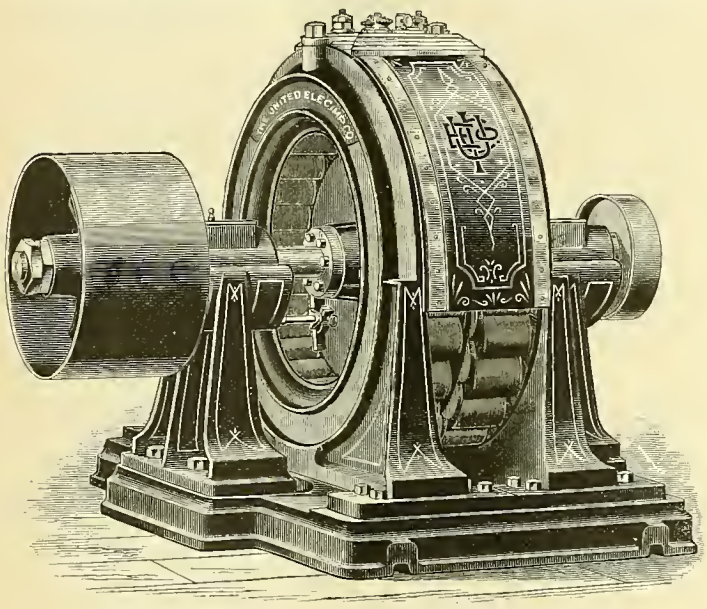
Adapted for Arc and Incandescent Lighting.
Guaranteed Equal in Every Respect to any other Type of Apparatus Manufactured.

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Direct Current Apparatus for Lighting Factories, Public Buildings and Isolated Plants.
Improved Long Distance Series Incandescent Apparatus for Street and Commercial Illumination.
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## THE HELIOS LAMP FOR STREET LIGHTING.

OFFICE OF BARNES BROTHERS,
Manufacturers of
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Wind Mills, Horse Power Stalk Cutters, Iron Pumps, House Castings. Dealers in all kinds of Farm Machinery, Steam Fittings and Brass Goods. Creamery Outfits a Specialty.
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Helios Electric Co

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Gentlemen:

In regard to the Helios Lamps we have in use on our Street-Circuit will say; We now have 26. 2000 C.P. Helios Lamps running on our Streets and giving good satisfaction. The first installation of 17 Lamps was made subject to acceptance by the City Council, and before they would accept the lights, they had an Expert test and report made. The Lamps was sustained as to Candle Power and General efficency. And the result was an order for 8 more Lights by the City and 1 by the County on Court House Grounds. They give a very clear steady white light, entirely free from the flaking and dying out of the ordinary Direct Current Arc Lamp.

Yours Truly
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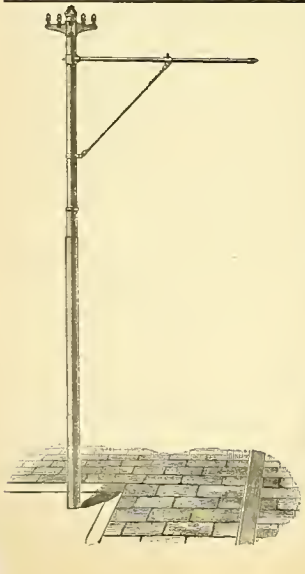

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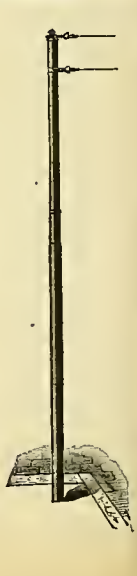

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# Construction Tools

## For Electric Light, Street Railways,

### Telephone and Telegraph Co's.

ABOUT this time of year a general inspection of lines and miscellaneous outside equipment is in order. Slack pulled in, poles reset, curves strengthened up, pins and insulators replaced, etc.

We invite Superintendents and Foremen to examine our complete and well selected stock of Construction and Repair Tools.

We have all the old standard tools and every new device of any merit.

**IMPROVED POST-HOLE AUGERS,**
**SHOVELS, SPADES, SPOONS, SCOOPS,**
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**PLAIN SPIKED and CRESCENT PIKE POLES,**
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**CANT HOOKS, CARRYING HOOKS.**

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We hold ourselves in readiness to "railroad" orders with a neatness and dispatch to satisfy the most urgent demand.

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Okonite Wire, Interior Conduit, Helios Arc Lamps, Lundell Fans, Washington Carbons, Sechrist Automatic Switches.

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We are able to supply our own goods, and those of the manufacturers whose Western representatives we are, without the usual intervening profit of the jobbers. Our line has been very carefully selected and contains only well known and reliable goods. It includes the following:

**Electric Railway Supplies, Habirshaw Wires and Cables, Shield Brand Wire, Weatherproof Wire, Magnet Wire, Trolley Wire, Office and Annunciator Wire, Incandescent Lighting Supplies, Wirt Dynamo Brushes, W. W. Lightning Arrester, Brush and Bar Copper, Arc and Incandescent Lamps, Fan Motors, Switches and Switch Board Material, Measuring and Indicating Instruments, Batteries, Bells and all Electrical House Goods.**

WRITE FOR WHAT YOU WANT. QUALITY CONSIDERED, OUR PRICES ARE VERY LOW.

*We still have a large LOT of BARGAINS from the Ansonia Electric Co.'s stock at practically your own prices.*

## WALLACE ELECTRIC CO., 307 DEARBORN ST., CHICAGO.

# We Want Western Business.

# LA ROCHE ALTERNATORS.

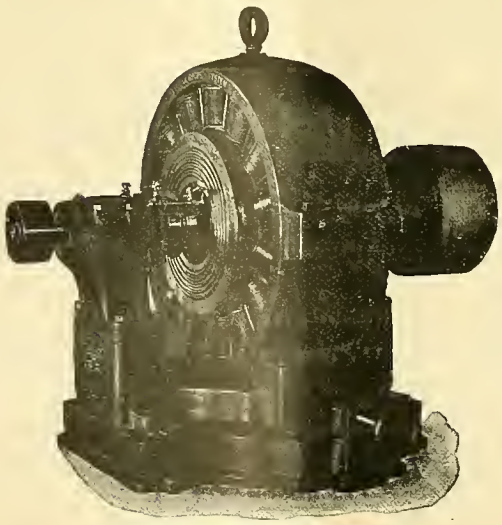
MANUFACTURED IN SIZES FROM

*25 to 5,000 Lights,*

SINGLE OR MULTIPHASE.

Direct Connected Dynamos.

Direct Current Generators.



1,000 Light Alternator.

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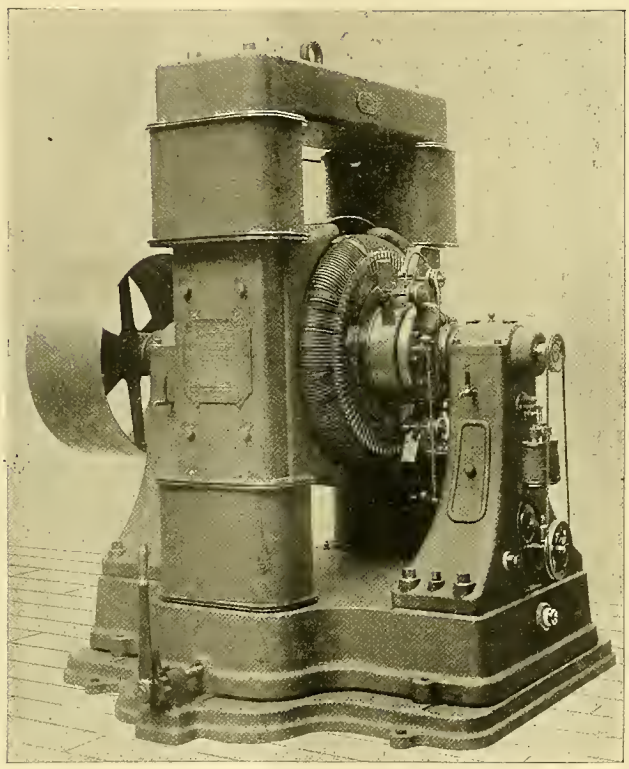
## FORT WAYNE, IND.,

MANUFACTURERS OF

# Electrical Machinery

Under the PATENTS OF JAMES J. WOOD.

**LOW PERIOD DIRECT CONNECTED ALTERNATORS.**



**Complete Apparatus for Arc, Direct Current Incandescent and Alternating Incandescent Lighting also for Power Transmission either by Direct or Alternating Currents.**

The New Wood Arc Dynamo, No. 10; Capacity 125, 2000 c. p. Lamps.

## ARC LAMPS for Constant Potential, Alternating or Railway Circuits.

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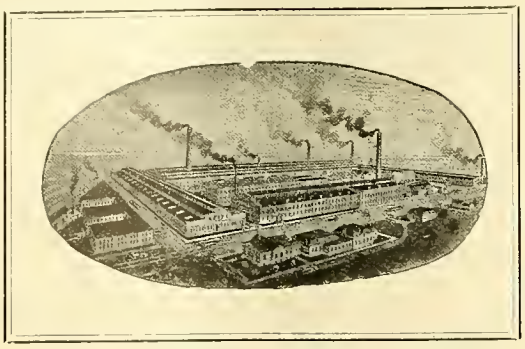

The Brush Double Arc Lamp Patents sustained by repeated decisions of U. S. Courts.

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Agencies in all large cities.
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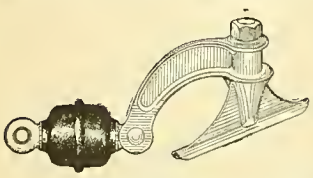

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Designed with reference to strength, durability, high insulation, reliability and practical fitness for the work they have to do. In universal use.

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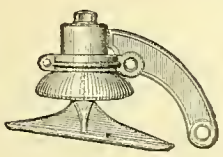

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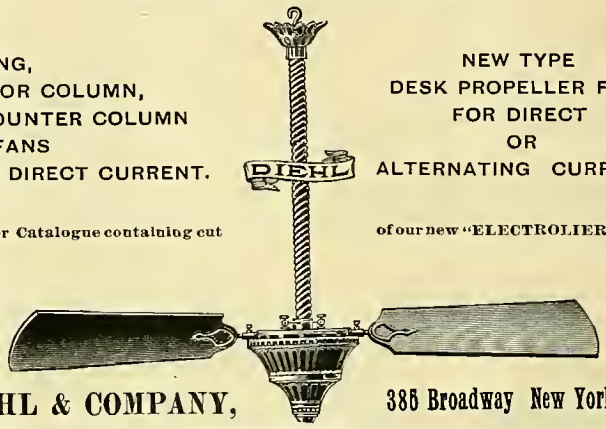
NO BELTS. NO SHAFTING.

CEILING, FLOOR COLUMN, COUNTER COLUMN FANS FOR DIRECT CURRENT.

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**No possible chance for an accident, as the Switch cannot be closed until the resistance is all in.**

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Every Telephone Company in the United States is using Kerite Wire and Cables. Kerite is the Standard of High Grade Insulation, and will Cut Last and Out Class any other on the Market.

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Direct Driven or Belted, in sizes up to 250 H. P.

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Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
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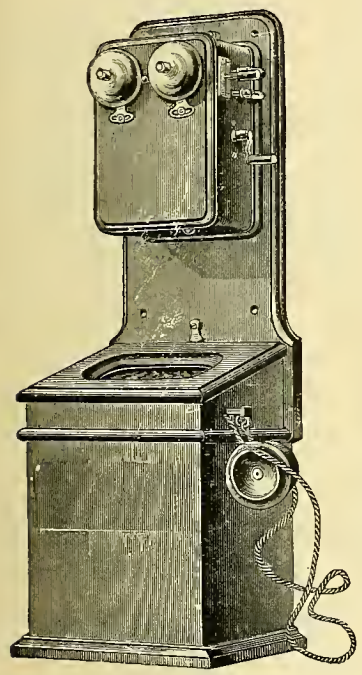

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Long Distance Battery Transmitters of the latest and newest designs sold outright.
No adjustment.
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Nothing demanding repair.
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A Telephone Receiver of the newest and best pattern.
Unique in design.
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No unsightly thumb-screws.

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New Prices given on Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters

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*This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.*

## OUR SERIES LAMPS

*Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.*

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We are sending out each month what we call our

# MONTHLY BLOTTER

Which is a first-class combination blotter and an attractive and useful article in any office. With this we combine a

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For each month.
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Remember us frequently with orders for ELECTRICAL SUPPLIES, and we will reciprocate by giving your business prompt and intelligent attention.

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Scrap and Native Platinum Purchased.
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**The Dow Adjuster**

Is a thoroughly reliable mechanism for instantly raising or lowering an electric light. The lamp can be placed at any height as easily as a window shade can be raised or lowered.

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For Electrical and Mechanical Purposes, Railway Dust Guards, Washers, and Packings. Pat. Insulating Cleats.
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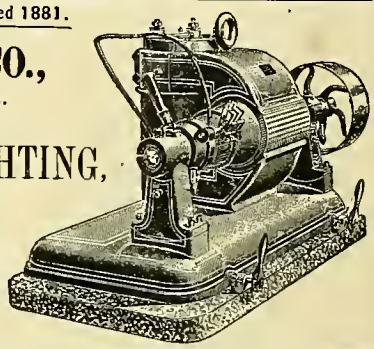

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Are copied extensively in this country as "Drum Type." We are building these machines in sizes from 1 H. P. to 150 H. P.

**ALTERNATING AND MULTIPHASE CURRENT DYNAMOS**
With laminated field and armature, in sizes from 1 H. P. to 4,000 H. P., for belted or direct coupling.

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Of every speed for direct, alternating or multiphase current, in sizes from 1-10 H. P. up to 4,000 H.P. Durable and economical in operation.

**SIEMENS BAND LAMPS**
For direct and alternating current, for constant potential and series machines.

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With either solid or soft cores, which are the most economical in the world and give a steady light.

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Requisite for the regulation of electric apparatus; also the Siemens Voltmeters and Ammeters and Automatic devices made in Berlin.

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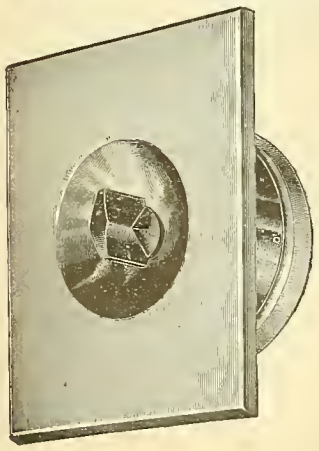

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10 Ampere Double Pole.
10 Ampere Three-way.

**The Only Snap Switch that has**
**PROVEN A SUCCESS.**

**For Sale by All Supply Houses.**

**The Hart & Hegeman**
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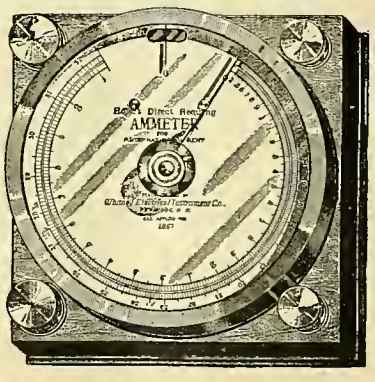
The **Hoyt Standard Ammeters** and **Voltmeters** for **Lamp** and **Meter** measurement on **Alternating Currents** are now ready for the market.

Send for our **1894 Catalogue** which contains the above and other new instruments of our manufacture.

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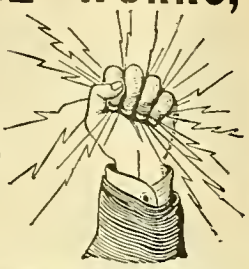

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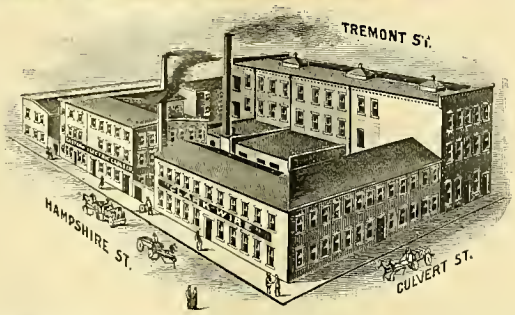


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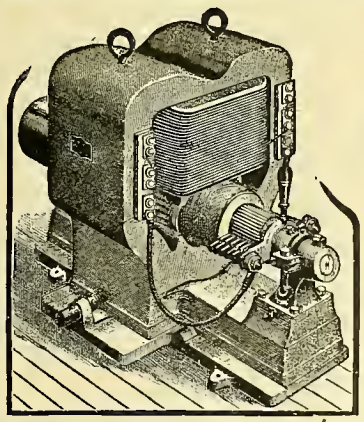

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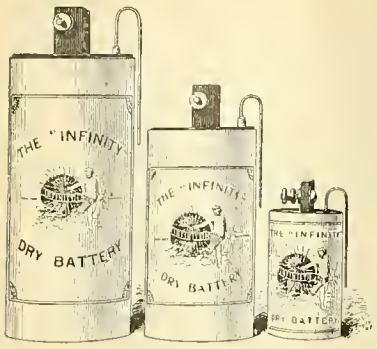


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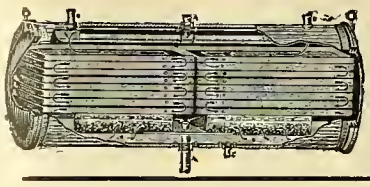

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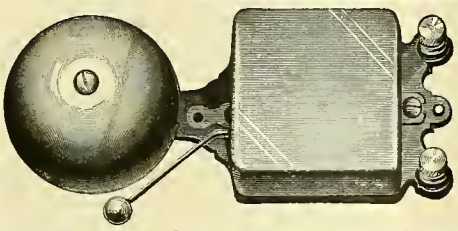

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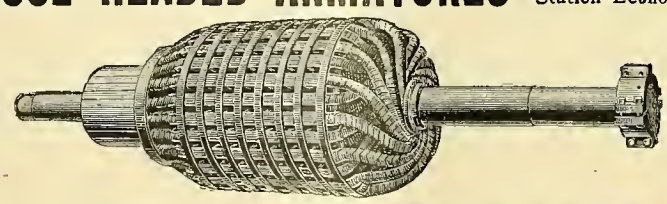

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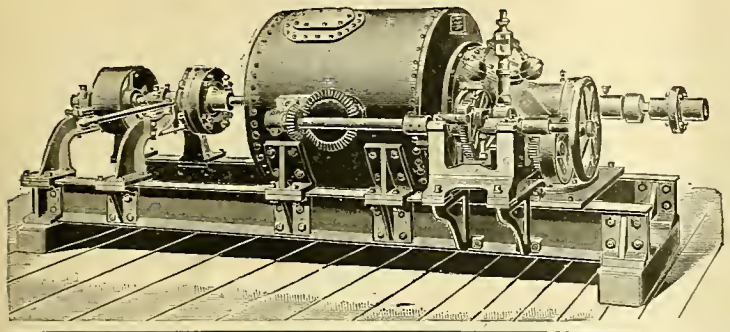

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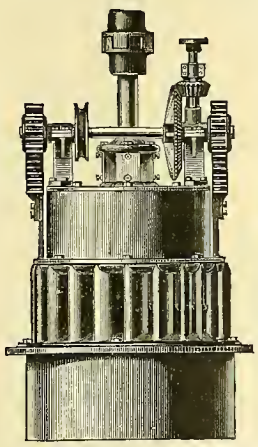

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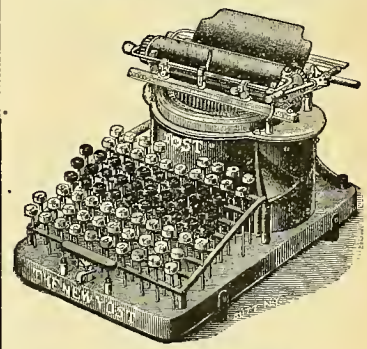

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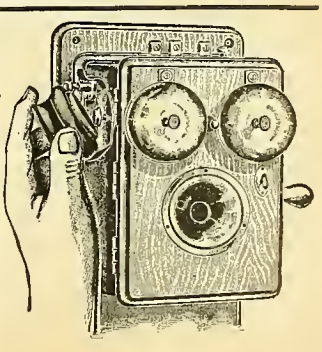

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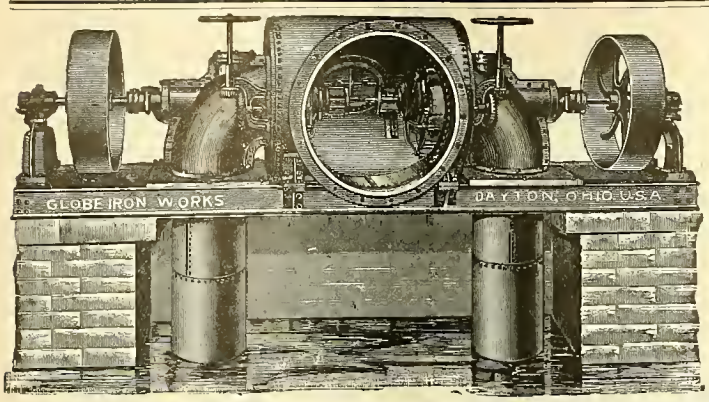


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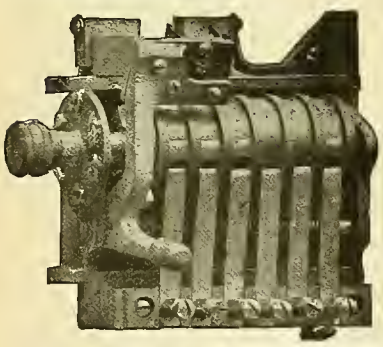

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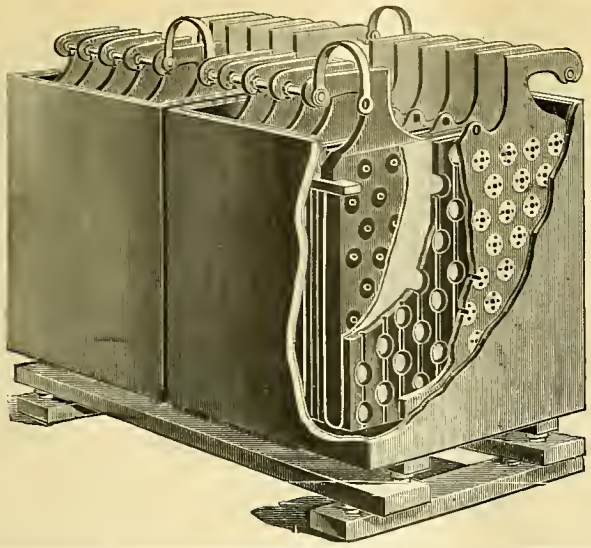

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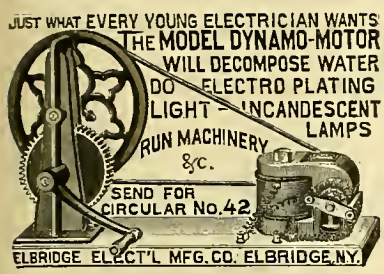


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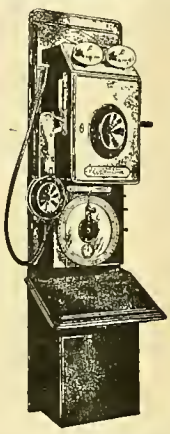

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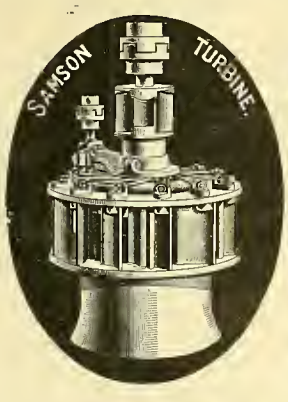


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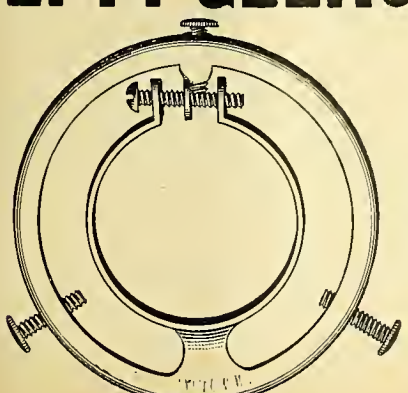

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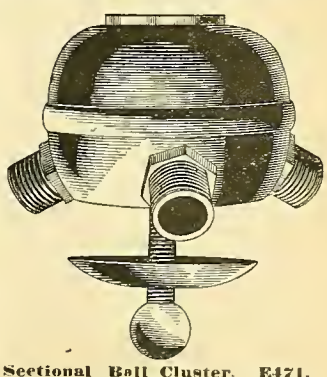

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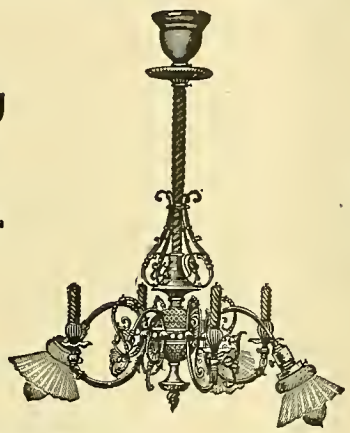

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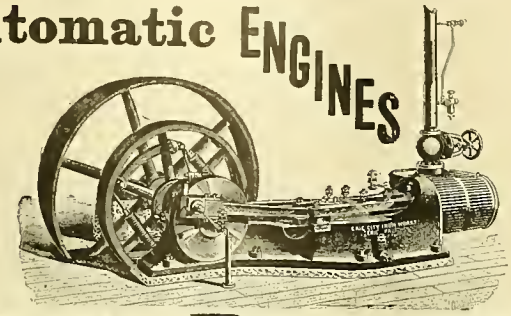

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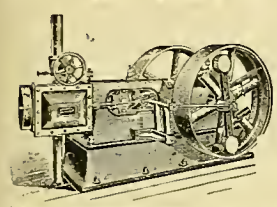

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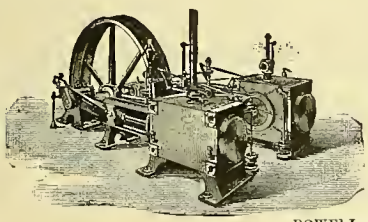

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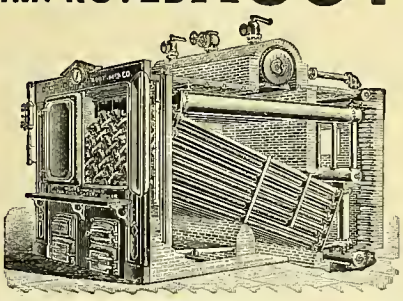

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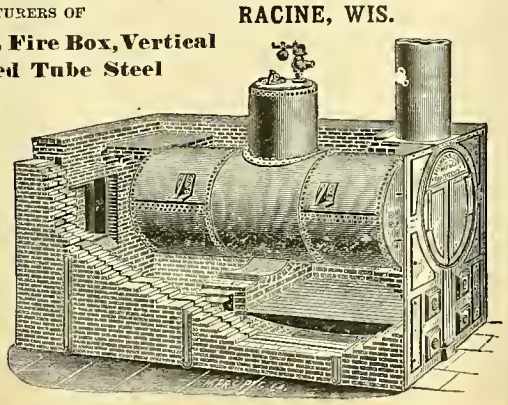

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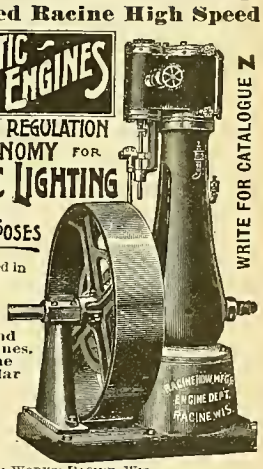

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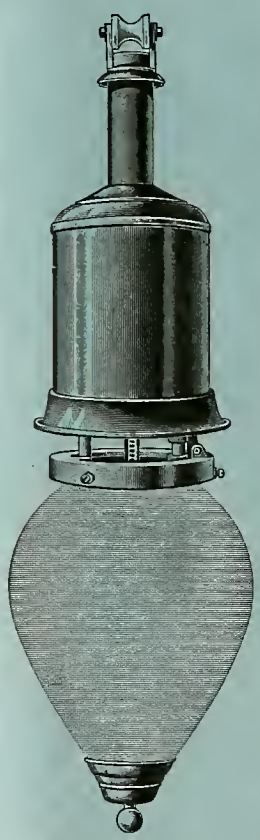

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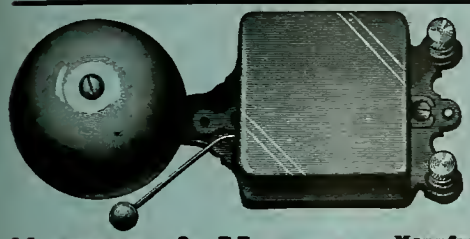

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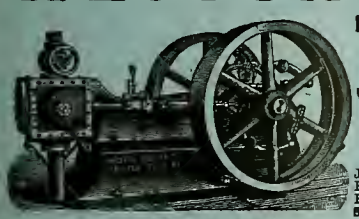

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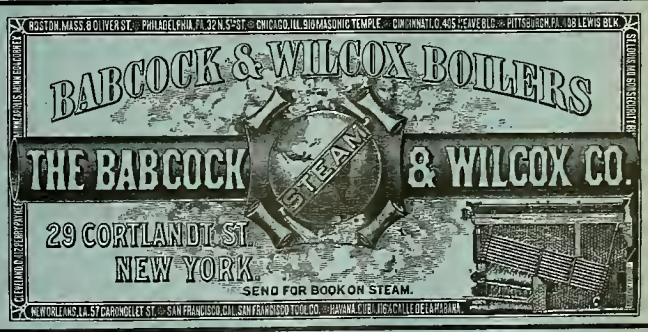


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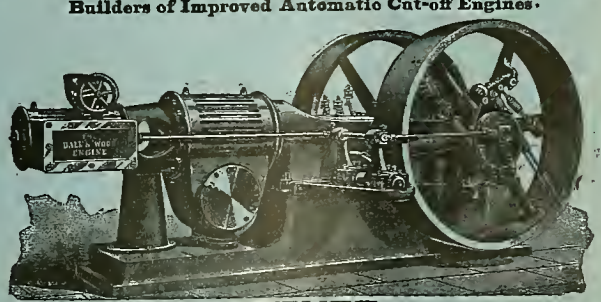

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C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Electric Railways.**
Brush Electric Co.
General Electric Co.
Hubley Mfg. Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Cameron & Gillett.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Osburn, Harry G.
Roberts & Co., E. P.
Rushmore, S. W.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng. & Iron Wks.
Weston Engine Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Central Electric Co.
Interior Conduit & Ins. Co.
Muncie Elec. Mfg Co.

**Fibre**
Butler Hard Rubber Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.

**Gears.**
Nuttall Co., R. D.

**General Elec. supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Palmer Bros.
Porter & Buerdorf.
Sioux City Brass Works.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason E. P. Mfg. Co.
Hemingray Glass Co.
Hubley Mfg. Co.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.
Hubley Mfg. Co.

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Butler Hard Rubber Co.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
Hemingray Glass Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Johns Mfg. Co., H. W.
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Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
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New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Vulcanized Fibre Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
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Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Ins. Wire Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Hubley Mfg. Co.
Independent Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
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**Lamps, Incandescent.**
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Mather Electric Co.
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Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Wirt, Chas.

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(See Insulated Wires.)

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**Mica.**
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Munsell & Co., Eugene.

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Independent Electric Co.
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Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co
Gregory, Chas. E. Co
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wallace Electric Co.
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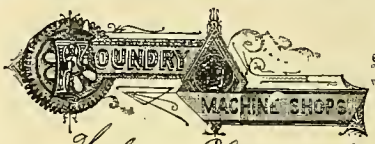


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F. A. ESTEP, President and Treasurer.
J. R. McGINLEY, Vice-President.
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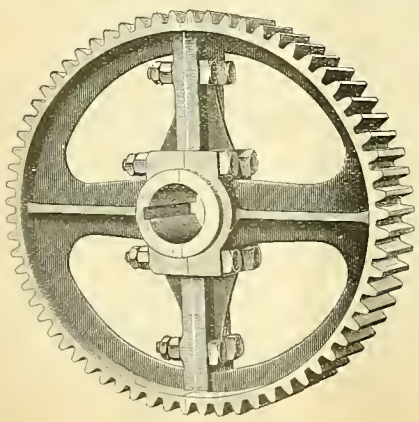

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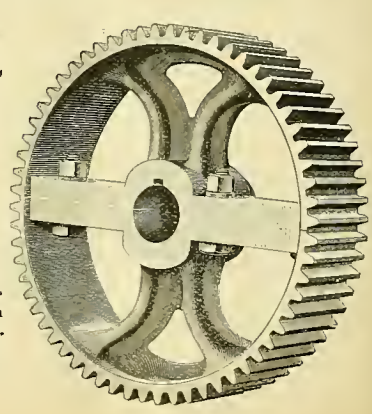
TRY IT ONCE. AND YOU WILL WANT NO OTHER.



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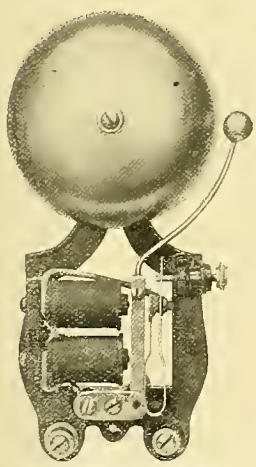
Is—well to tell the truth we are unable to discriminate. Okonite is possessed of so many rare qualities and is of such homogeneous merit that it would be a difficult task to point to this or that distinguishing feature and say, "herein is the chief virtue."

We doubt if there is, in the world, a man having any very intimate interest in Electrical Work who is not familiar with, if he has not actually used, Okonite Wire in some one of its many applications. There is but one way to account for such a precedence, for such universal appreciation—

**It never disappoints.**



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Nothing is more annoying than to be called a long distance just to chase a bug out of the contact-points, or to blow away a speck of dust. Various insect proof frames and boxes have been designed, but in each the really *vital* point was left unprotected. **In this bell** *the contact points are sealed.* No bug, no dust or other obstruction can prevent ringing. We have this bell in various sizes. Also a full line of House Goods Specialties, Annunciators, Batteries, Insulated Wires, Push Buttons and Construction Tools.

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Have highest award on insulated electric light wire.

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GROUP 126; CLASS 769—KERITE INSULATED WIRE FOR ELECTRIC LIGHT SERVICE.

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First. ***HIGHEST*** excellence in insulating qualities.
Second. Durability of insulation under conditions found in commercial service.
Third. Uniform high excellence in mechanical qualities of insulation.

NOTE.—This report is based upon the results of exhaustive tests approximating the various conditions to be met with in practice by insulated wires in electric light service.

D. C. JACKSON, Individual Judge.
HENRY S. CARHART, President Department Committee.

These facts, together with the favorable testimonials of thousands who are using ***Kerite*** to-day, fully substantiate our claims that

## KERITE INSULATED ELECTRIC WIRES AND CABLES

Will out-test and out-class any other on the market

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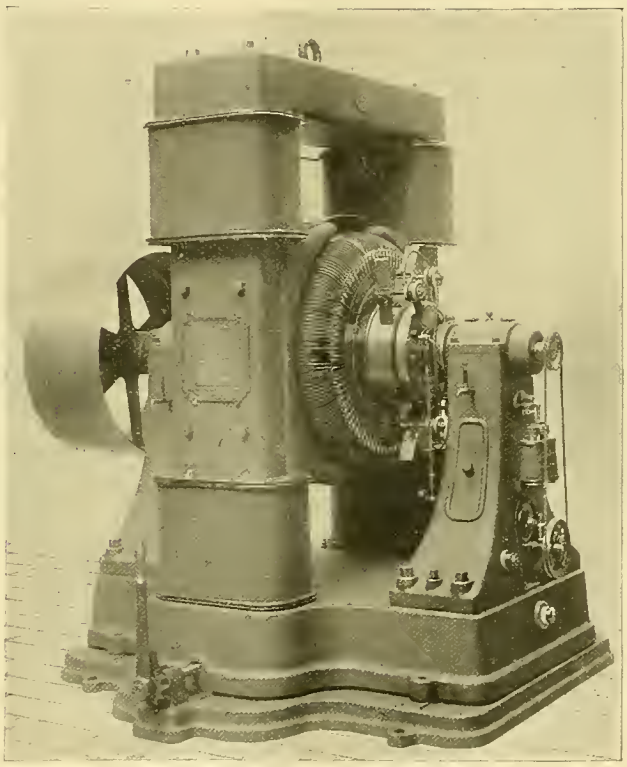
Under the PATENTS OF JAMES J. WOOD.

**LOW PERIOD DIRECT CONNECTED ALTERNATORS.**



**Complete Apparatus for Arc, Direct Current Incandescent and Alternating Incandescent Lighting also for Power Transmission either by Direct or Alternating Currents.**

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# BUILDING AND INSULATING PAPER

**Manufactured under U. S. PATENT No. 378,520.**

**The validity of this Patent has been judicially established in the case of**

## The Standard Paint Co. vs Henry J. Bird and James L. Reynolds,

Where, after an exhaustive litigation extending over four and a quarter years, and after consideration of a printed record of upwards of one thousand pages, the Circuit Court of the United States for the District of New Jersey, on July 5th, 1894, made and entered a decree adjudging that the Patent was valid and had been infringed by the defendants and directing an injunction against the defendants and an accounting.

The opinion of the Court written by Hon. George M. Dallas, Circuit Judge, holds that the Patent covers any Paper coated with a solid residuum obtained from the distillation of Petroleum and that the manufacture and sale of any substantially similar paper is an **INFRINGEMENT** of the Patent.

The coating mentioned, and which, as established by the evidence in the case and by decree of the Court, was first used by this Company and protected by the U. S. Patent referred to, makes an ***Odorless, Water, Acid and Alkali Proof,*** and thoroughly ***Insulating Paper,*** as is well-known.

The Court holds that Papers possessing these essential characteristics, which were new up to the time of their introduction under the name of ***P. & B.,*** made by others, a violation and infringement of our rights.

We beg to caution the public against the purchase of such infringing papers, as we shall enforce our rights in every instance.

Our prices remain the same as heretofore, and ***the best paper,*** the ***P. & B.,*** can be had from us, on short notice, and in any quantities.

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Sole Manufacturers East of the Rocky Mountains.

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Sole Manufacturers West of the Rocky Mountains.

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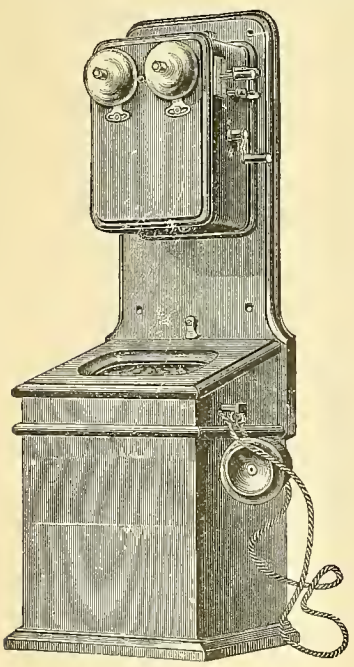
## WHY NOT OWN YOUR TELEPHONE?



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- Long Distance Battery Transmitters of the latest and newest designs sold outright.
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- A Telephone Receiver of the newest and best pattern.
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This Company owns the patent for the improved switch for changing the circuit of the telephone on battery transmitters. Also, for perfected system of telephone exchanges. The best dry battery manufactured.

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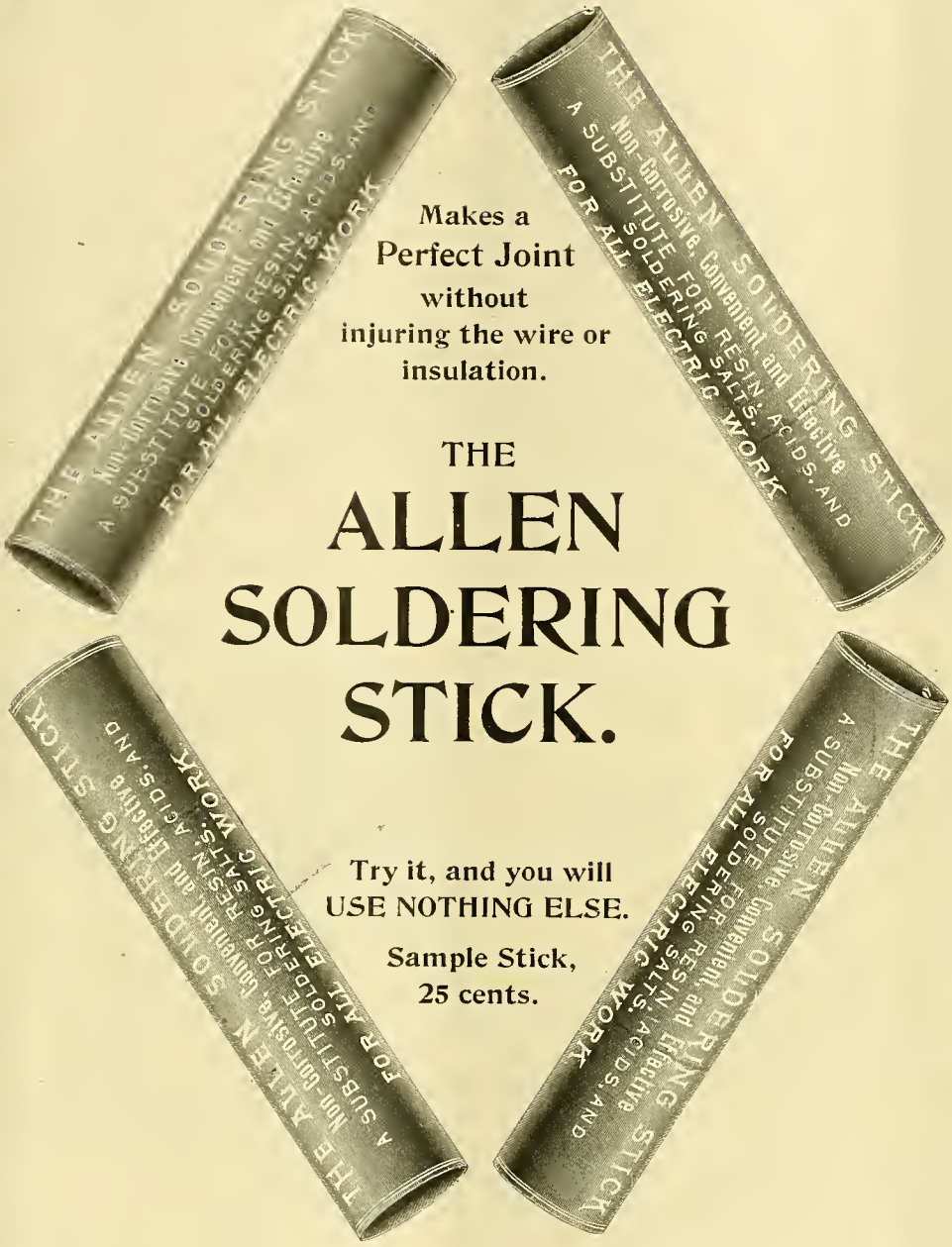


Makes a
Perfect Joint
without
injuring the wire or
insulation.

## THE ALLEN SOLDERING STICK.

Try it, and you will
USE NOTHING ELSE.

Sample Stick,
25 cents.

# Electric Appliance Company,

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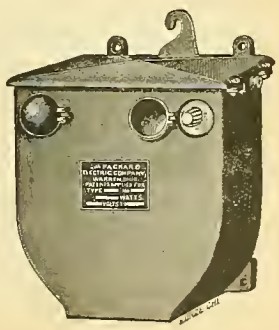

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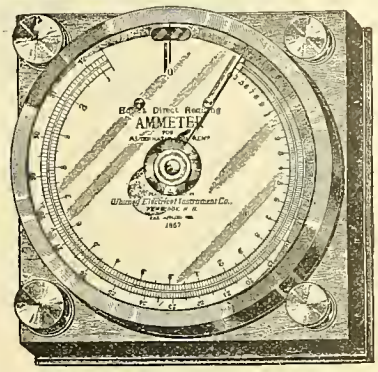
The **Hoyt Standard Ammeters** and **Voltmeters** for **Lamp** and **Meter** measurement on **Alternating Currents** are now ready for the market.

Send for our **1894 Catalogue** which contains the above and other new instruments of our manufacture.




## Whitney Electrical Instrument Co.,

**PENACOOK, N. H.**

Factories: Penacook, N. H.; Sherbrooke, P. Q., Can.

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I have purchased the Wirt Laboratory from the assignee of the Ansonia Electric Co., together with a large stock of Wirt Indicators; these instruments are all new and in first-class condition. They include indicators for direct and alternating current ranging from 10 to 1,000 amperes and from 2½ to 3,000 volts. While this stock lasts I will make extremely low prices. Apply to the undersigned or to your regular dealer

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Suitable for all Incandescent Dynamos, Plating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.

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For under ground, under water, and all other conditions.

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AGGREGATING IN CAPACITY **260,425 Horse Power,** ARE NOW IN USE.

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"NATIONAL" COMPOUND RECEIVER.

# THE "NATIONAL."

We make simply a business proposition. Buy two sets of our instruments and make your own tests. If satisfactory the way is open for more business, either in telephones or switchboards for exchanges.

**Our head telephones are largely used by Bell telephone operators.**

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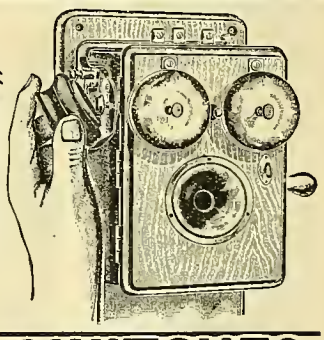
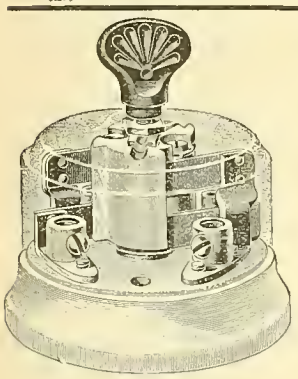


"NATIONAL." Method of Placing Receiver in Holder.



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DOUBLE POLE

## SNAP SWITCH,

MADE BY THE

**BRYANT ELECTRIC COMPANY,**

1532 MONADNOCK BLOCK, CHICAGO.

THOS. G. GRIER, EDWARD R. GRIER, Western Representatives.

**Factory: Bridgeport, Conn.**

*Sockets, Switches, Cut Outs, and Electrical Specialties. Good Goods and Prompt Shipments.*

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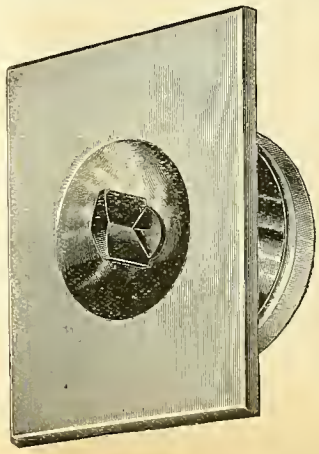

5 and 10 Ampere Single Pole.
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10 Ampere Three-way.

**The Only Snap Switch that has**

**PROVEN A SUCCESS.**

**For Sale by All Supply Houses.**

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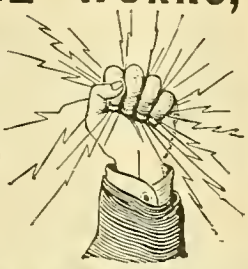
RAILWAY FEEDER AND TROLLEY WIRE,

ELECTRIC LIGHT LINE WIRE,

Incandescent and Flexible Cords,

AMERICANITE. MAGNET. OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



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## W. U. Double Petticoat Teat Insulator.

The points or teats on the lower rim of the petticoat attracts the water on the outer surface of the insulator into drops. The water drops from these points on to the cross-arm, thereby preventing the moisture from creeping up on the inner petticoat, and thence to the pin. Owing to the great success of our Patent Teat Insulator in Telegraph Work, where the efficiency of the Insulator has proven to be more than twice that of the ordinary Insulator, we have concluded to apply the device to all Insulators for Telegraph, Telephone and Street Railway Work.

**Standard Screw Glass Insulators, Floor Insulators, Glass Break Knobs, Battery Jars, Arc Light Globes for all Systems. Colored Glass Insulators to designate different currents**

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Send Model or Drawing and we will furnish estimates.

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THE

# "CLARK" WIRE.

TRADE MARK.

For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

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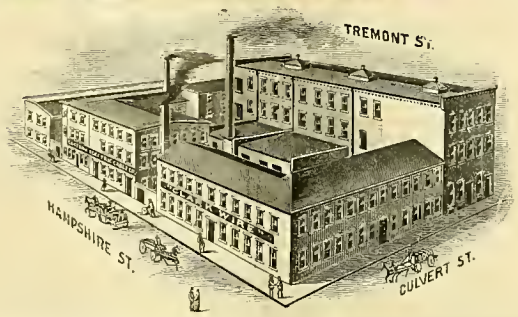
GREAT WESTERN MFG. CO.,
Chicago, Ill.




In a Letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A Thoroughly Reliable and Desirable Wire in every respect."

The Rubber used in insulating our Wires and Cables is especially chemically prepared, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat.

We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first class Insulated Wire.

We shall be pleased to mail Catalogues with Terms and Discounts for Quantities.

**EASTERN ELECTRIC CABLE CO.,**
61 and 63 Hampshire St., Boston, Mass.

Henry A. Clark, Treas. and Gen'l Mgr. Herbert H. Eustis, Prest. and Electrician

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Dynamos and Motors AND PARTS OF SAME
ALL KINDS PRICES OF PARTS TELEPHONES
ELECTRICAL SUPPLIES
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Manufacturers of all kinds of
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And Dealers in
Everything in the Battery Line.
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Single Pole—Double Pole—Commutation; 3 Wire, 4 Wire.

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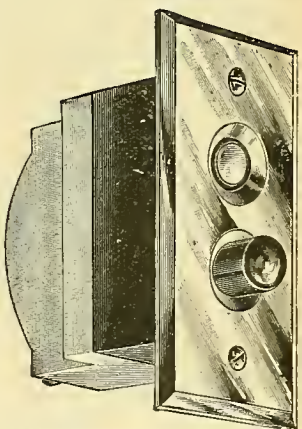
**C-S Flush Automatic Switch.**
Single Pole.

ELECTRICALLY MECHANICALLY ARTISTICALLY **PEERLESS.**



C-S Flush Double Push Switch—Double Pole.

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"O.K."
LINE AND HOUSE WIRES

Chicago Agents,
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—MANUFACTURERS OF—

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For Electric Railway and Electric Light Work.

Superior Quality. Perfect Insulation. Handsome Finish,

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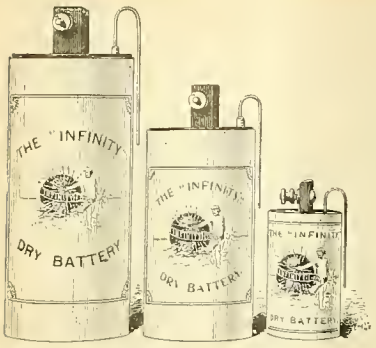


# BATTERIES DRY. BATTERIES WET.

## Electrical Supply Department.

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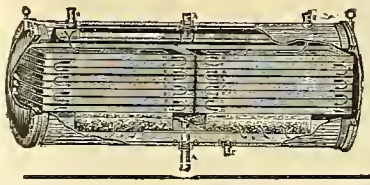

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Entirely prevents *scale* in Steam Boilers. Catalogue on application.

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120 Second-hand Machines, all sizes.
Write us for what you want.

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Five H. P. 220 Volt Motor. Purchaser can see it run. Guaranteed to be in first class condition. Write for particulars.

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In electrician's office or as draftsman, by a college graduate with seven years' experience as draftsman and chief draftsman with railroad and electrical manufacturing concerns. Address *"Steady,"*
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The Committee reserves the right to reject any or all bids.

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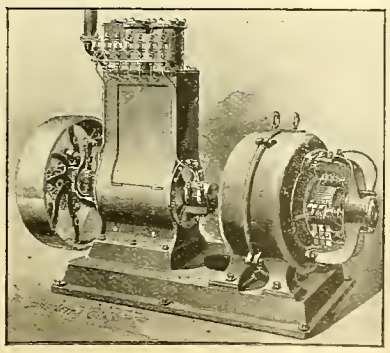

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**Direct Current, Slow Speed, Iron Clad,**

In Sizes up to 30 Kilowatts.

Lundell Dynamos directly connected to any type of high speed engines.

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Storage batteries for traction work *sold with guarantee* of 20,000 miles without repairs. Installation of storage battery lighting plants a specialty
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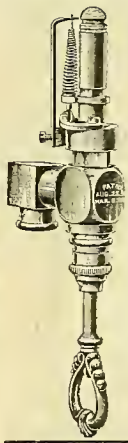

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**Newly Improved.**

**Are the only Electric Lighters made that are successfully operated by the key,**

Which always indicates whether the gas is on or off. Safe, reliable; will not fail to light; have interchangeable stems; are adaptable to any fixtures, and fully guaranteed. Made in 5 styles but all on the same general principle as style shown. Candle, Billiard, Argand. Our **Victor** with side lever, is a little wonder.

AMERICAN ELECTRIC CO.,
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FOR ALL PURPOSES.
Bradbury-Stone Electric Storage Co.,
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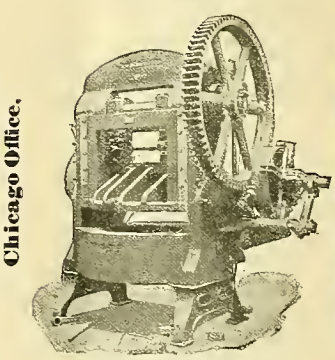

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This Press is Designed for

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**Punches, Shears, Drop Hammers, Dies, Etc., For Electrical Work.**

**The Stiles & Parker Press Co.**

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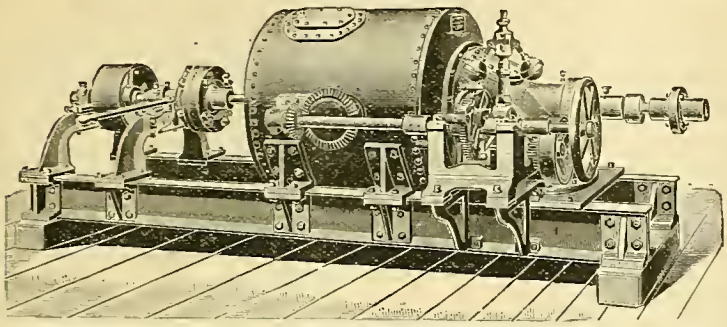

Cylinder or Register Gate—Close Regulation and High Efficiency at Full and Partial Gate.

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter**, being **double the power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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The accompanying engraving represents a single 10-inch Victor Turbine on horizontal shaft to develop 36 H. P. under 38 feet head. Arranged with 12-inch Worrell Friction Coupling at one end to disconnect pulley.

We are now prepared to furnish Victor Turbines, either single or in pairs, on horizontal shafts, and where the situation admits of their use we recommend them.

**The Stilwell-Bierce & Smith-Vaile Co., Dayton, O.**

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'TWAS MANY MOONS AGO

THAT WE BEGAN AT THE BOTTOM OF THE LADDER,

BUT BY STRICT ATTENTION TO BUSINESS AND BY STRIVING TO OUR UTMOST ABILITY TO DO TOWARD OUR CUSTOMERS AS WE WOULD BE DONE BY, WE TO-DAY FIND OURSELVES

HERE AT THE TOP OF THE LADDER

WITH OUR

DOUBLE CYLINDER CELL,
VARIOUS OTHER CELLS,
SAL AMMONIAC,
BLUE STONE
CARBON PLATES,
PLUNGE BATTERIES,
ZINCS, ET CETERA.

**LAW BATTERY COMPANY,**

85 JOHN STREET, NEW YORK.

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***The Standard Open Circuit Batteries of the World.***

SEND FOR CIRCULAR AND PRICES.

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*111 to 117 East 131st St., N. Y.*

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**Graphite Rods of Various Lengths, from 1-5 Ohm to 100 Ohms Resistance to the inch. Graphite Boxes and Crucibles, Resisting Heats of 4,000 Degrees. Inquiries Gladly Answered.**

**JOS. DIXON CRUCIBLE CO., Jersey City, N. J.**

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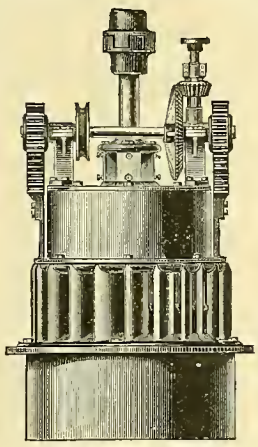

## THE McCORMICK TURBINE,

On Vertical or Horizontal Shaft,
Especially Adapted for Electric Work.

**Gives more power as to diameter with a higher percentage of useful effect than any other water-wheel heretofore made.** All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with me, **as I am willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

**S. MORGAN SMITH, York, Pa.**

Estimates furnished for complete power plants and results guaranteed.

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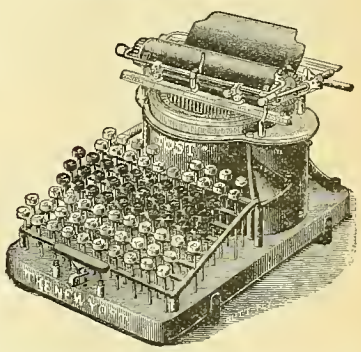

Constructed on principles radically its own, insuring results always sought for but absolutely unattainable in the construction of any other machine. It is pre-eminently the telegrapher's and professional stenographer's typewriter.

Let us send you catalogue.

**The Yost Writing Machine Co.,**

169 La Salle St., CHICAGO.

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# New York Insulated Wire Co.,

**Sole Manufacturers,**

Grimshaw White Core and Raven Core Wires, Grimshaw Underground Lead Covered Cables,
Competition Line Wires, Grimshaw Tapes and Splicing Compound,
Vulca Bushings, all sizes, Vulca Electrical Wire Ducts for Interior Construction.

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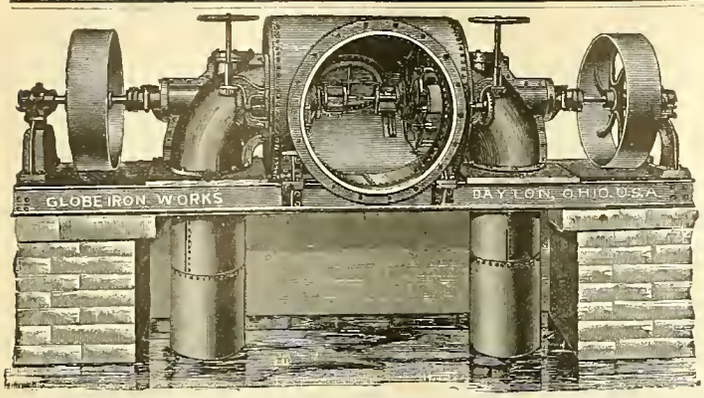


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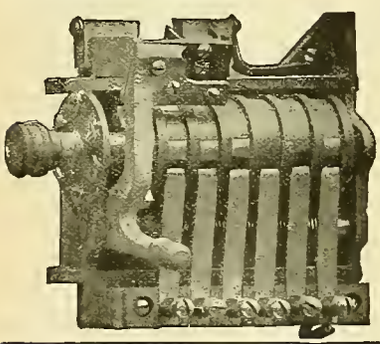

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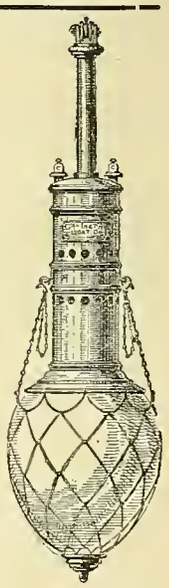

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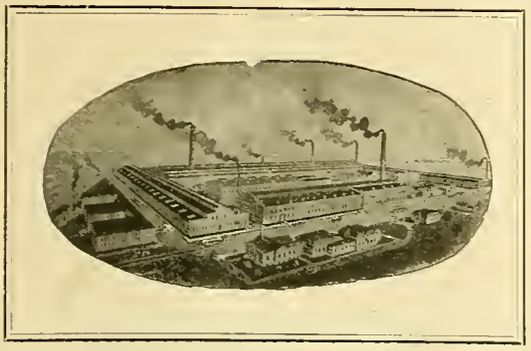

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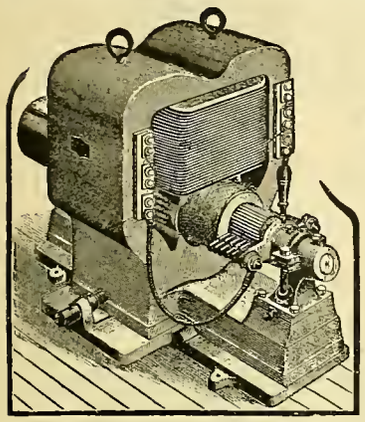

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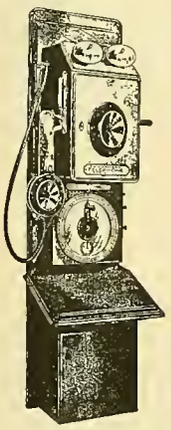

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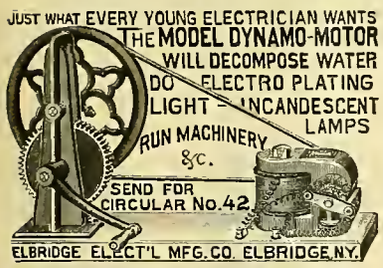


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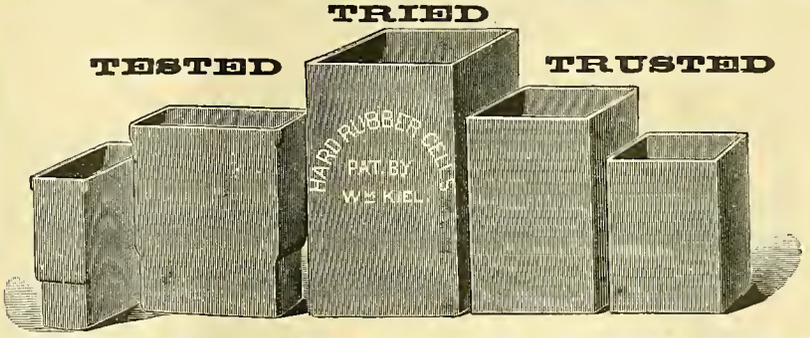


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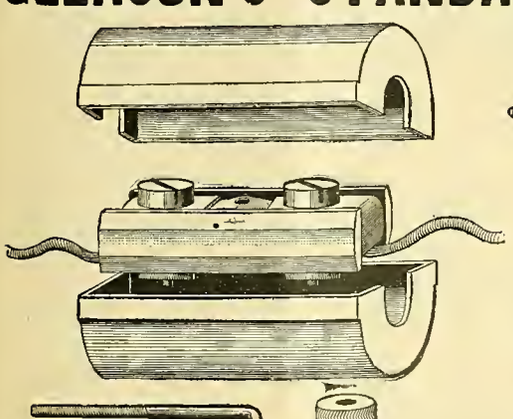

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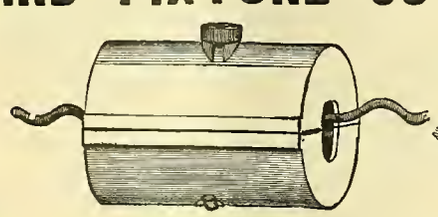

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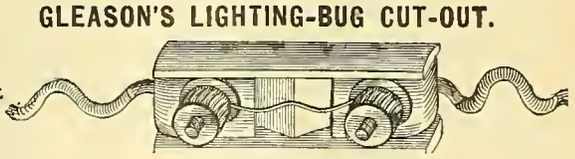

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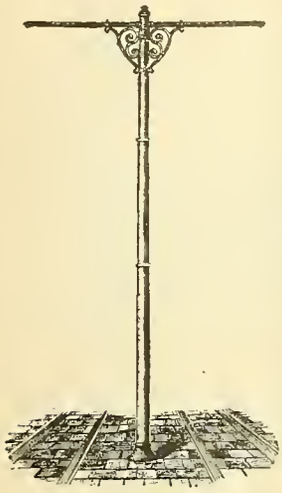

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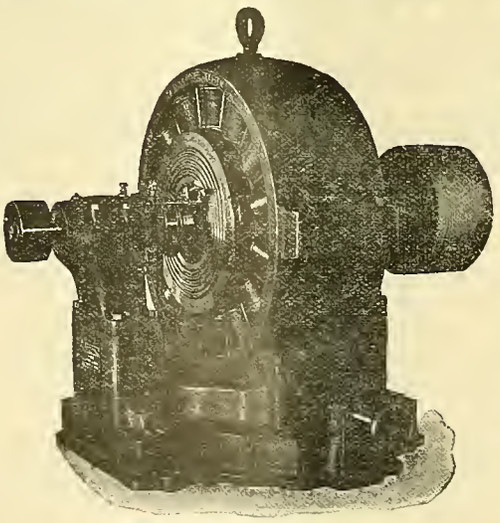

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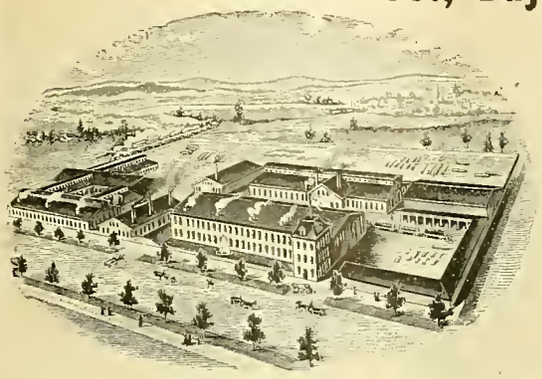

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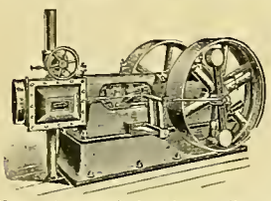

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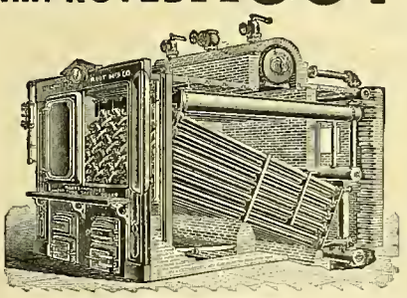

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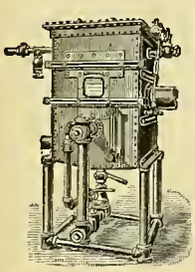

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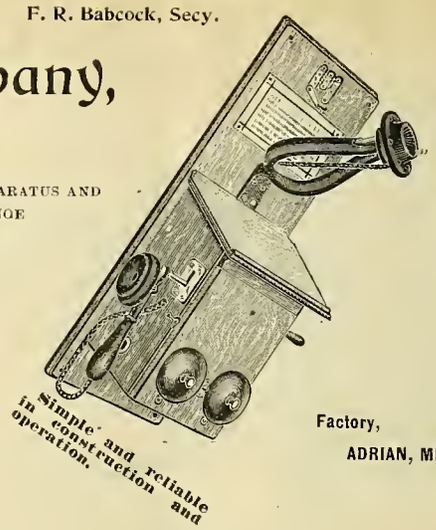


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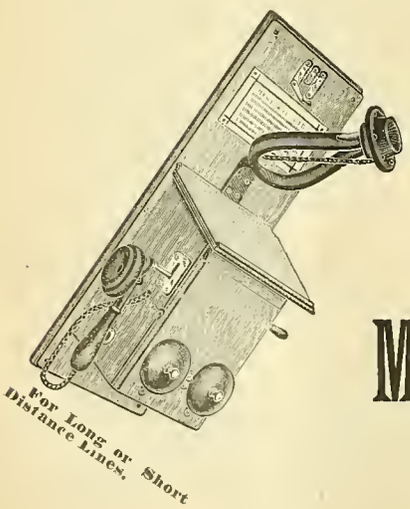
We are now prepared to sell outright Telephones, Magneto Transmitters, Magneto Bells, Telephone Switchboards and Apparatus.

The Gilliland Telephone Company is incorporated and thoroughly organized for the further purpose of constructing Telephone Exchange plants, building private lines, or equipping Hotels, Factories, Resident Apartments or Department Stores with a complete Telephone speaking tube system. Our Telephone set consists of Magneto Call Bell, Desk and Back-board, Hand Receiver with Cord and Bi-Polar Magneto Transmitter, neatly and compactly put together in a style familiar to the public, and our aim has been to supply a Telephone which will give satisfaction both electrically and mechanically. In principle of construction, those features are embodied which experience in Telephone service demonstrate to be the most efficient and reliable. Complicated mechanism has given place to simplicity of construction, and our Telephone set as it stands to-day is without doubt the best instrument yet offered to the public. Telephone experts who have made careful and thorough tests verify this statement and unhesitatingly pronounce our Telephone absolutely first-class.

We employ men of experience and ability for the purpose of Telephone Exchange construction and electrical work, and are prepared to furnish estimates promptly, or contract for electrical work at once. Correspondence solicited.

GILLILAND TELEPHONE COMPANY.

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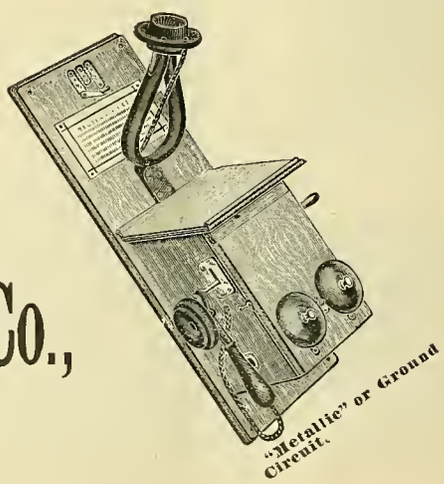
# Metropolitan Electric Co.,

186 and 188 Fifth Ave., Chicago.



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**TROLLEY WHEELS,** Bronze, Brass or Iron, patent graphite bearings, a *10,000 mile record*—Still running.

**TROLLEY HARPS,** Brass, Bronze, Malleable Iron or Steel. Light, strong, new design. Cheapest and best on the market.

**BEARINGS** For Dynamos and Motors. We guarantee 20 per cent. more life than any anti-friction metal offered for sale.

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**It will pay you to do so, as its earning capacity is much greater than anything else on the market.**

Light and Power can be supplied by this system from the same generator and circuit.

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**Is superior to all others in efficiency, simplicity, durability and inherent regulation.**

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**Are self starting, take current in proportion to their load, substantially as direct current motors do, and are more simple, durable and convenient to use than direct current motors.**

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**Excel all others in efficiency, regulation, convenience, safety and durability. We insure them for a term of years at a small premium.**

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# INCANDESCENT LAMPS.

Manufactured by

American Electric Mfg. Co.

WRITE FOR REDUCED PRICES.

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India and Amber Qualities for Electrical Purposes.

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PERFECT INSULATOR.

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Current free as it connects with any faucet. Sample $6.00. Wholesale and retail.

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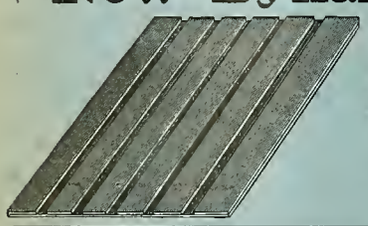
## New Dynamo Belting.



Patent Grooved Belting having Grooves running lengthwise of the Belt, serve as channels to permit the escape of air between Belt and Pulleys, to such a degree that the air cushion is overcome and the Belt can be run very slack, thereby taking the heavy strain from the bearings.

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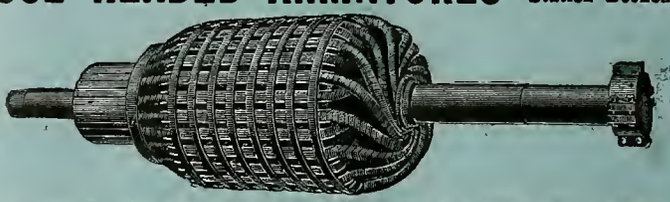

The above cut is of a 175 K. W. Generator wound on our new open-head spiral system. All coils alike, perfect balance, handsome appearance. Write for prices on **HEAVY CENTRAL STATION REPAIRS**; *Large Commutators*, Search Lamps and Station Dynamos.

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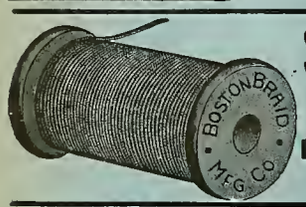


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The greatest care taken in producing a uniform article.

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ARC LAMP
NOW ON
THE MARKET.

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Constant Current Circuits,
Constant Potential Circuits.

Write for prices.

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Established 1881.

Unity Building, Chicago.

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# BUCKEYE INCANDESCENT LAMPS

Monadnock Building, Chicago.

## TO FIT ANY STANDARD SOCKET.

Judge Ricks' decision against the Edison Company and in our favor, frees these lamps from any taint of infringement. Order no other.

THE BUCKEYE ELECTRIC CO., Cleveland, O.

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Vol. XV. CHICAGO, AUGUST 18, 1894. No. 7



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Send for Samples.

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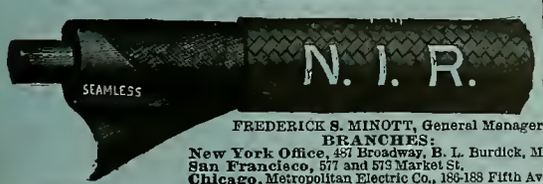
Manufacturers,

Troy, N. Y.

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Manson Protecting Tape.
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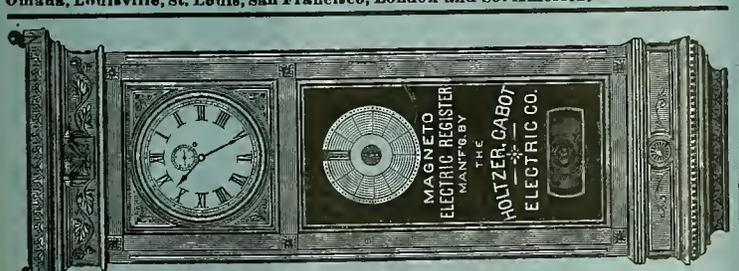


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PRICES REDUCED.

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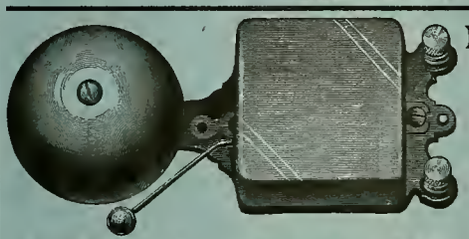

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FLOOR PUSHES,
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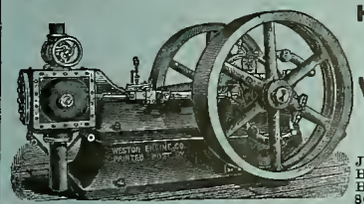

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Complete Power Plants.

Estimates and Drawings Submitted.

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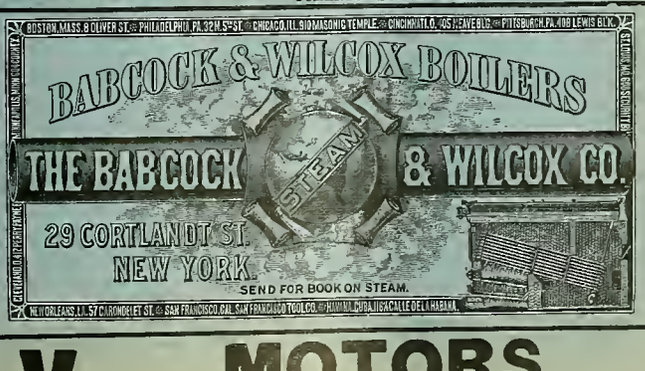


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*All Apparatus Guaranteed as Represented.*

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IN THIS COUNTRY TO BE

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Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Oshnrn, Harry G.
Roberts & Co., E. P.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co , J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Chicago Ins. Wire Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Chicago Cross Arm Co.
Electric Appliance Co.
Hubley Mfg. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Sioux City Brass Works.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Electric Railways.**
Brush Electric Co.
General Electric Co.
Hubley Mfg. Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Cameron & Gillett.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Osburn, Harry G.
Roberts & Co., E. P.
Rushmore, S. W.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
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**Electric Slate.**
Independent Electric Co.

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Chi. Gen'l Fixture Co.
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Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

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Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Weston Engine Co.

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Central Electric Co.
Interior Conduit & Ins. Co.
Muncie Elec. Mfg. Co.

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Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

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Western Electric Co.

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General Electric Co.
Independent Electric Co.

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American Electric Co.
Holtzer-Cabot Electric Co.

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Grant, Geo. B.
Nuttall Co., R. D.

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Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Caoot Electric Co.
Bubley Mfg. Co.
Interior Conduit & Ins. Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Palmer Bros.
Porter & Buerdorf.
Sioux City Brass Works.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
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Hubley Mfg. Co.

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Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
Hemingray Glass Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
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New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Vulcanized Fibre Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
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Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Ins. Wire Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Hubley Mfg. Co.
Independent Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

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Beacon Vac Pump & Elec.Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Mather Electric Co.
Metropolitan Electric Co.
New York & Ohio Co.
Rafferty & Co., T. C.
United Elec. Imp. Co.
Westinghouse Elec. & Mfg. Co.

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Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Wirt, Chas.

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**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

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Bolgiano Mfg. Co.
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C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
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General Electric Co
Gregory, Chas. E. Co
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wallace Electric Co.
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Rushmore, S. W.

**Sal Ammoniac**
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Innis & Co.
Klipstein, A. & Co.
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Rushmore, S. W.

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**Speaking Tubes.**
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Electric Appliance Co.
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Worthington, Henry R.

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Cushing & Morse.
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Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
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Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Western Electric Co.

**Telephones,**
D'Unger Loug Dist. Tel. Co
Harrison Int. Telephone Co.
National Telep. Mfg. Co.
Palmer Bros.
Western Electric Co.
Western Tel. Const. Co.

**Transformers.**
General Electric Co.
Hornberger Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

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Westinghouse El. & Mfg. Co.

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Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

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**Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Water Wheels.**
Leffel & Co:, Jas.
Smith, S. Morgan.

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Bishop Gutta Percha Co.
Central Electric Co.
Electric Appliance Co.
In ependent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.

# THE LADY OR THE TIGER?

**Coal Bills versus First Cost**—Is it cheaper to buy the lowest in price and take your chances or to buy a **Good Wire** and be **Sure**—**is it?**

Which Central Stations pay the best dividends—those having equipment with price as the only consideration, or those in which quality is of first importance and price second?

**SIMPLEX WIRE** answers both these questions in favor of wise business judgment in the purchase of a **High Grade** of insulation. **It pays in the end.** Write for prices.

**Simplex T. Z. R. Weatherproof,** **Simplex Caoutchouc Wire.**

**SIMPLEX ELECTRICAL CO.,** WESTERN OFFICE, **1137-1138 Monadnock, Chicago.**

# Cross Arms,

NOTHING BUT

# Cross Arms.

MADE OF **YELLOW** (GEORGIA) **PINE.**

Government Tests show that this wood is the BEST for EXTERIOR WORK. 40 per cent. Stronger, Lasts 35 per cent. Longer than Northern Pine.

## Chicago Cross Arm Co.,

932 Monadnock Blk., - CHICAGO.

## R. D. NUTTALL COMPANY, Allegheny, Pa.

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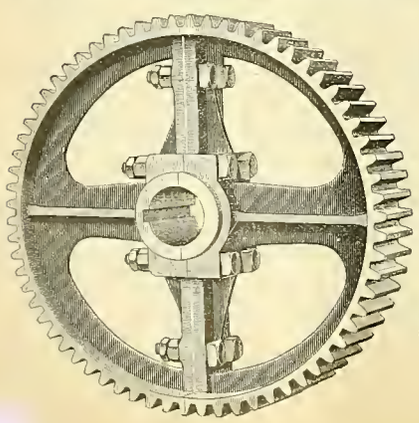
F. S. MARTIN, Superintendent of Works.



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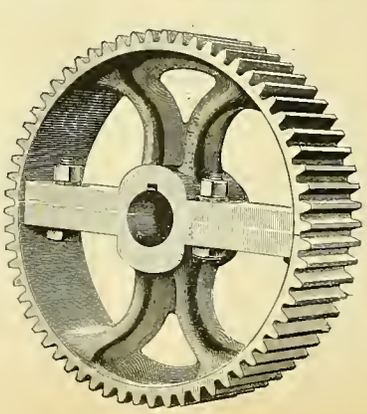
**Electric Railway Supplies.**

**GEARS, PINIONS, BEARINGS, TROLLEYS, TROLLEY WHEELS AND HARPS.**

THIS IS THE IMPROVED NUTTALL TROLLEY.

TRY IT ONCE, AND YOU WILL WANT NO OTHER.



**The largest and most prosperous street railway companies in the country are using our supplies, and they prefer them to all others on account of greater strength and durability. Correspondence solicited.**

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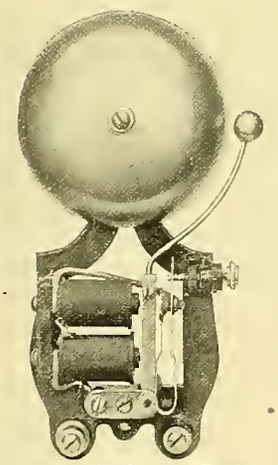
CHAS. N. WOOD, 180 Summer St., Boston, Mass., New England States.
STANDARD RY SUPPLY CO., Monadnock Block, Chicago, Ill., Northwestern States.
A. S. PARTRIDGE, Bank of Commerce Building, St. Louis, Mo., Southwestern States.
CHAS. A. CAVAGNA, Neave Building, Cincinnati, Ohio, Central States.

# One of the Beauties of Okonite

Is—well to tell the truth we are unable to discriminate. Okonite is possessed of so many rare qualities and is of such homogeneous merit that it would be a difficult task to point to this or that distinguishing feature and say, "herein is the chief virtue."

We doubt if there is, in the world, a man having any very intimate interest in Electrical Work who is not familiar with, if he has not actually used, Okonite Wire in some one of its many applications. There is but one way to account for such a precedence, for such universal appreciation—

**It never disappoints.**



This is the Contact Protected Dust-Proof Bell.

## Here is a Bell

That will meet the instant approval of every Contractor or Bell-fitter who has had to contend with the numerous difficulties in the way of assuring his customers uninterrupted service.

Nothing is more annoying than to be called a long distance just to chase a bug out of the contact-points, or to blow away a speck of dust. Various insect proof frames and boxes have been designed, but in each the really *vital* point was left unprotected. **In this bell** *the contact points are sealed.* No bug, no dust or other obstruction can prevent ringing. We have this bell in various sizes. Also a full line of House Goods Specialties, Annunciators, Batteries, Insulated Wires, Push Buttons and Construction Tools.

*Orders and correspondence given prompt attention.*

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**Central Electric Company,**
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Okonite Wires, Interior Conduit, Lundell Fans, Helios Arc Lamps, Washington Carbons, Carpenter Enamel Rheostats.

# Reduction in Prices.

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## WIRES, CABLES AND CORES.

The Highest Grade of Rubber Insulation.

The Habirshaw Standard Red Core Wires have been on the market a great many years, have an established reputation, and under any adequate comparative test will demonstrate their superiority.

**LET US BID ON YOUR SPECIFICATIONS. WE CAN MAKE YOU SATISFACTORY PRICES.**

# ARC LAMPS.

We have the ***largest*** and ***best*** line of Plain and Ornamental Lamps on the market.

**ARC LAMPS** (single) for 110 Volt Circuits.
**ARC LAMPS** (twin) for 110 Volt Circuits.
**ARC LAMPS, Focusing.**
**ARC LAMPS, Projectors.**
**ARC LAMPS, Theatrical,**
**ARC LAMPS, Series for Arc Circuits.**
**ARC LAMPS for Alternating Circuits.**
**ARC LAMPS for Railway Circuits.**

**The Best Lamps at Bottom Prices.**

**ELECTRIC RAILWAY SUPPLIES.** Our line is the best and most complete of any house in the business, and includes all Wood's Patented Specialties, which we control.

**ELECTRIC LIGHT GOODS.** We are first hands on all important electrical material and appliances.

**HOUSE GOODS.** Send for price list. Our line embraces well known and standard goods, such as the Ajax Dry Battery, Diamond Carbon Batteries, Eureka Box Bells, Ansonia Gravity Annunciators, etc., etc.

When in want of any Standard Electrical Goods write us. We are representatives of the manufacturers, and sell at the **lowest** manufacturers' prices.
We still have a Lot of Bargains from the Ansonia Electric Co 's Chicago stock.

# WALLACE ELECTRIC COMPANY,

## 307 Dearborn Street, CHICAGO.

# Fort Wayne Electric Corporation

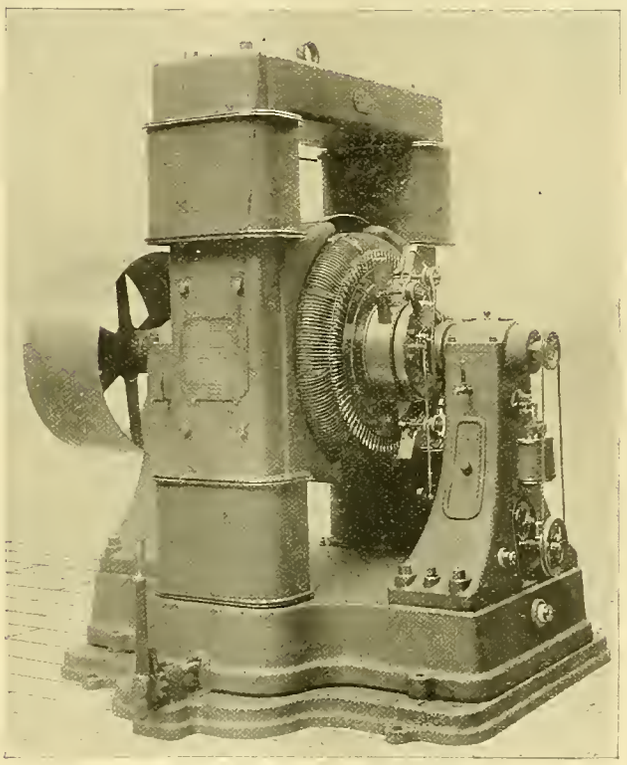
## FORT WAYNE, IND.,

MANUFACTURERS OF

# Electrical Machinery

Under the PATENTS OF JAMES J. WOOD.

**LOW PERIOD DIRECT CONNECTED ALTERNATORS.**



**Complete Apparatus for Arc, Direct Current Incandescent and Alternating Incandescent Lighting also for Power Transmission either by Direct or Alternating Currents.**

The New Wood Arc Dynamo, No. 10; Capacity 125, 2000 c. p. Lamps.

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## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

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BEST and SIMPLEST
ALTERNATING
ARC LAMP
NOW ON
THE MARKET.

....Also Arc Lamps for....

Constant Current Circuits,
Constant Potential Circuits.

Write for prices.

## THE F. P. LITTLE
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## PROTECT YOUR MOTORS
BY USING THE
## HILL PATENT SELF-LOCKING STARTING SWITCH.

No possible chance for an accident, as the Switch cannot be closed until the resistance is all in.

CHEAP. COMPACT. DURABLE.

MADE ONLY BY THE

## W. S. Hill Electric Co.,
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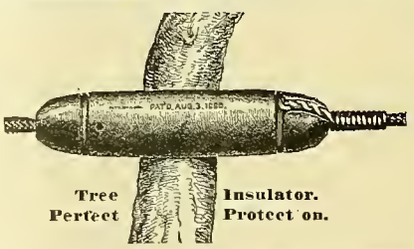
SEND FOR CIRCULAR AND PRICE LIST.

NEW YORK, ELSON & BREWSTER, 143 Liberty Street.
CHICAGO, CENTRAL ELECTRIC CO.




Tree Insulator.
Perfect Protection.

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TREE INSULATORS, WEATHERPROOF SOCKETS, ETC.,

## TROLLEY LINE INSULATORS

Are the recognized standard for strength, durability and superior insulating qualities.

Hangers, Pull-offs, Bracket Arm Insulators, Strain Insulators, Pole Insulators, Insulated Crossings, Frogs, Rail Bonds, Etc., Etc.

**VULCABESTON** Heat and Moisturepreof Insulation.

## H. W. JOHNS MFG. CO.,

New York, Philadelphia, Boston. 240 Randolph Street, CHICAGO.

# BUILDING AND INSULATING PAPER

**Manufactured under U. S. PATENT No. 378,520.**

The validity of this Patent has been judicially established in the case of

## The Standard Paint Co. vs Henry J. Bird and James L. Reynolds,

Where, after an exhaustive litigation extending over four and a quarter years, and after consideration of a printed record of upwards of one thousand pages, the Circuit Court of the United States for the District of New Jersey, on July 5th, 1894, made and entered a decree adjudging that the Patent was valid and had been infringed by the defendants and directing an injunction against the defendants and an accounting.

The opinion of the Court written by Hon. George M. Dallas, Circuit Judge, holds that the Patent covers any Paper coated with a solid residuum obtained from the distillation of Petroleum and that the manufacture and sale of any substantially similar paper is an **INFRINGEMENT** of the Patent.

The coating mentioned, and which, as established by the evidence in the case and by decree of the Court, was first used by this Company and protected by the U. S. Patent referred to, makes an *Odorless, Water, Acid and Alkali Proof*, and thoroughly *Insulating Paper*, as is well-known.

The Court holds that Papers possessing these essential characteristics, which were new up to the time of their introduction under the name of *P. & B.*, made by others, a violation and infringement of our rights.

We beg to caution the public against the purchase of such infringing papers, as we shall enforce our rights in every instance.

Our prices remain the same as heretofore, and *the best paper*, the *P. & B.*, can be had from us, on short notice, and in any quantities.

**The Standard Paint Co., New York,**
Sole Manufacturers East of the Rocky Mountains.

**The Paraffine Paint Co., San Francisco.**
Sole Manufacturers West of the Rocky Mountains.

# A GREAT REDUCTION IN PRICES ON OUR

# REFLECTOR PLATE ALTERNATING LAMP.

## We are Heavily Stocked with New Styles and Designs.

We claim for our lamp a better distribution of light than can be obtained from any other alternating lamp. We obtain this result by means of our reflector plate.

The only lamp that has a legal right to use a reflector plate. We guarantee 50 per cent. more effective light than can be obtained from any other alternating lamp.

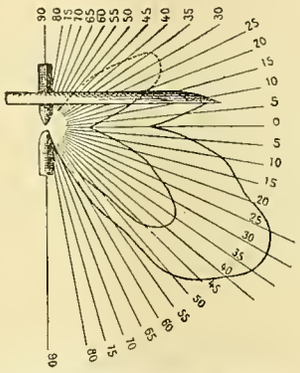


Diagram showing distribution of light with and without a reflector plate.

Our phenomenal sales are due to the reflector plate.

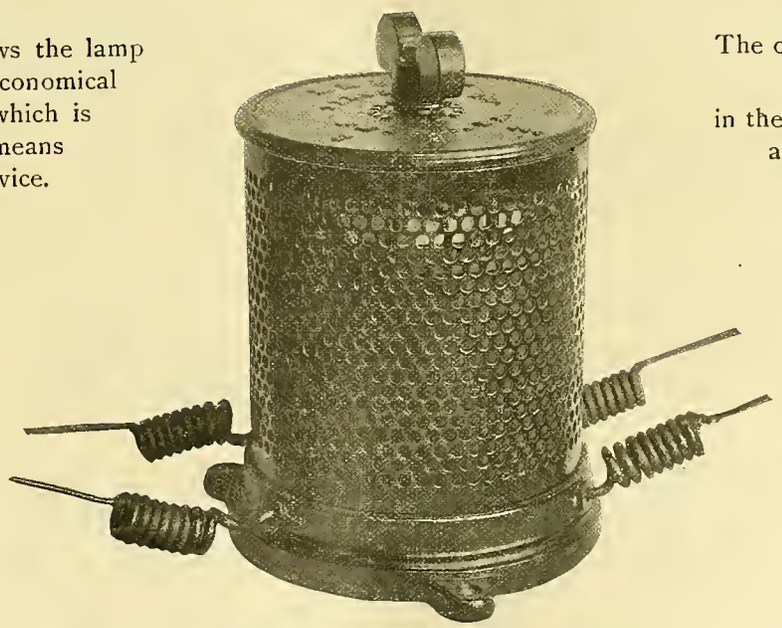
No alternating lamp can be a success without it.

We obtain more economy from our lamp than can be obtained from any other alternating lamp in the market. We do this by means of the

## SPENCER ECONOMY COIL.

The only Coil that allows the lamp to burn at its most economical voltage (28 volts), which is accomplished by means of its starting device.

The only adjustable **Economy Coil** in the market. It requires no resistance nor additional switch.



**Complete Installations for Inside and Street Lighting Purposes.**

**Direct Current Lamps. Photo-Engraving. Theatrical.**

## CARBONS.

*To Users of Helios Lamps:* August 15th.—Yearly contracts can be made for the **Helios Carbons** at greatly reduced prices. We can supply unlimited orders.

# Helios Electric Co.,

## 1306, 1308 and 1310 Filbert St., Philadelphia, Pa., U. S. A.

Eastern Agents: STANLEY ELECTRIC MFG. CO., Pittsfield, Mass.
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Of a 20-light Transformer overloaded 100% with the case nearly full of water that was never phased a particle?

# THIS IS WHAT

A Packard Transformer underwent.
We do not recommend this practice, but we do recommend all purchasers to buy the Packard.

**Largest Line of Electrical Supplies in the West.**

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OCTAGONAL PINE POLES,
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It will pay you to get our prices.
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Suitable for all Incandescent Dynamos, Plating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.
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For Electrical and Mechanical Purposes, Railway Dust Guards, Washers, and Packings. Pat. Insulating Cleats.
MANUFACTURED BY
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# WIRT INDICATORS.

I have purchased the Wirt Laboratory from the assignee of the Ansonia Electric Co., together with a large stock of Wirt Indicators; these instruments are all new and in first-class condition. They include indicators for direct and alternating current ranging from 10 to 1,000 amperes and from 2½ to 3,000 volts. While this stock lasts I will make extremely low prices. Apply to the undersigned or to your regular dealer
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BAKER & CO., 408-414 New Jersey Railroad Ave., Newark, N. J.

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*Clocks Sold. Clocks Rented.*

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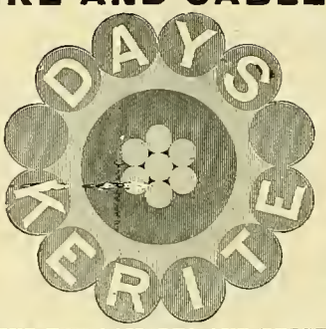
## WIRE AND CABLES.

Every Telephone Company in the United States is using Kerite Wire and Cables. Kerite is the Standard of High Grade Insulation, and will Cut Last and Out Class any other on the Market.

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# STREET LIGHTING FROM ALTERNATING CURRENT DYNAMOS.

New Prices given on Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters

**And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.**

*This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.*

# OUR SERIES LAMPS

*Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.*

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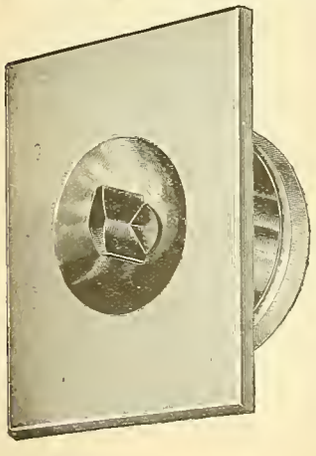
# HART FLUSH SWITCHES.



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The Only Snap Switch that has
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The Hart & Hegeman
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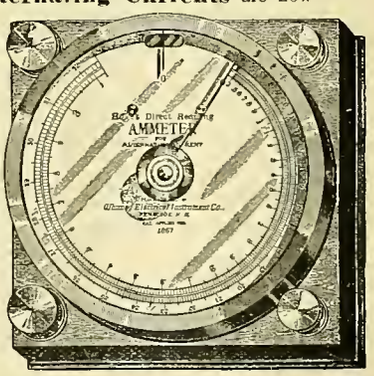
The **Hoyt Standard Ammeters** and **Voltmeters** for **Lamp** and **Meter** measurement on **Alternating Currents** are now ready for the market.

Send for our **1894 Catalogue** which contains the above and other new instruments of our manufacture.

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Factories: Penacook, N. H.; Sherbrooke, P. Q., Can.
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RAILWAY FEEDER AND TROLLEY WIRE,

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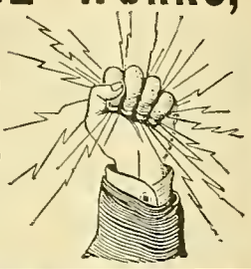
Incandescent and Flexible Cords,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



NEW YORK OFFICE, P. C. Ackerman, 10 Cortlandt Street.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works

## W. U. Double Petticoat Teat Insulator.

The points or teats on the lower rim of the petticoat attracts the water on the outer surface of the insulator into drops. The water drops from these points on to the cross-arm, thereby preventing the moisture from creeping up on the inner petticoat, and thence to the pin. Owing to the great success of our Patent Teat Insulator in Telegraph Work, where the efficiency of the Insulator has proven to be more than twice that of the ordinary Insulator, we have concluded to apply the device to all Insulators for Telegraph, Telephone and Street Railway Work.

**Standard Screw Glass Insulators, Floor Insulators, Glass Break Knobs, Battery Jars, Arc Light Globes for all Systems, Colored Glass Insula ors to designate different currents**

**WORK ON SPECIAL DESIGNS A FEATURE.**

Send Model or Drawing and we will furnish estimates.

**HEMINGRAY GLASS CO.,**

ESTABLISHED 1848.

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THE

# "CLARK" WIRE.

TRADE MARK.

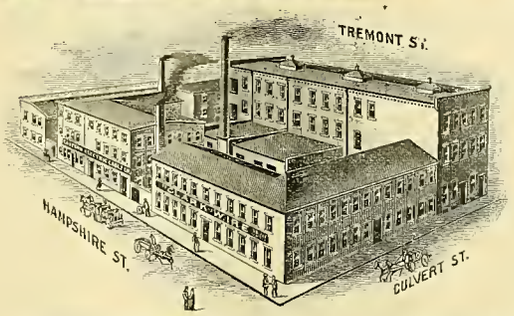
For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

**Western Agents,**

**GREAT WESTERN MFG. CO.,**

**Chicago, Ill.**




**In a Letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A Thoroughly Reliable and Desirable Wire in every respect."**

The Rubber used in insulating our Wires and Cables is especially chemically prepared, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat.

We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first class Insulated Wire.

We shall be pleased to mail Catalogues with Terms and Discounts for Quantities.

**EASTERN ELECTRIC CABLE CO.,**

61 and 63 Hampshire St., Boston, Mass.

HENRY A. CLARK, Treas. and Gen'l Mgr. HERBERT H. EUSTIS, Prest. and Electrician

**Send for Catalogue.**

Dynamos and Motors AND PARTS OF SAME

ALL KINDS PRICES OF PARTS TELEPHONES ELECTRICAL SUPPLIES

SEND STAMP FOR CATALOGUE PALMER BROS. MANUS, CONN.

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**BRUSH PATENTS,**

Licenses Granted.

EDISON BUILDING, NEW YORK.
DREXEL BUILDING, PHILADELPHIA.

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**CLEVELAND, OHIO.** Instruction by Correspondence, Electrical, Steam and other Branches of Engineering.—E. P. Roberts, M. E.; G. T. Hanchett, S. B.; Oscar Antz, M. E.; Jas. Ritchie, B. S.; Frank C. Osborn, C. E.; F. Yensen; L. S. Siebel; H. J. Cook; J. N. Richardson; W. B. Sewart and F. H. Constant, C. E. Send for Circular.

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HAYDEN-BOOKER MFG. COMPANY,

Manufacturers of all kinds of

OPEN AND CLOSED CIRCUIT CELLS,

And Dealers in

Everything in the Battery Line.

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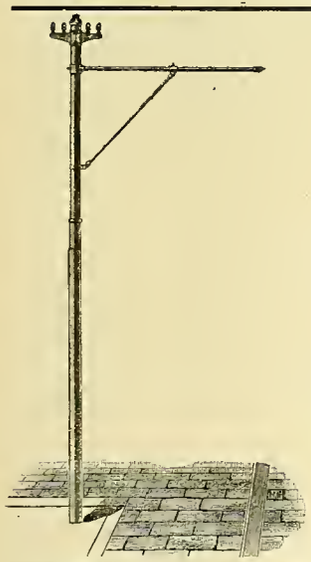
M. M. HAYDEN, President and Manager.



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**INCORPORATED.**

Offices, 222-224 S. Third St., Philadelphia, Pa.

PASCAL IRON WORKS, PHILADELPHIA.

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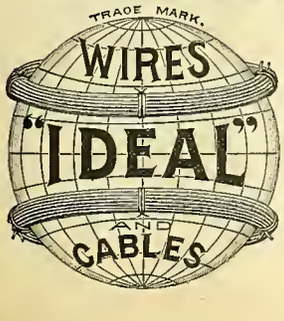
**Manufacturers of**

## Boiler Tubes, Wrought Iron Pipes and Fittings.

ELECTRIC LIGHT and RAILWAY PIPE POLES A SPECIALTY.

# "IDEAL" INSULATED COPPER WIRE.

**Approved by the New York Board of Fire Underwriters.**



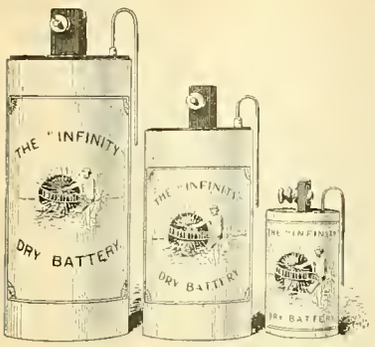

The Only Authorized FIBRE COVERED WIRE for INSIDE, TUBE and CONCEALED WORK GENERALLY.

**It will not Deteriorate by long use, nor Oxidize the Copper. Finished in the following Styles: Black Polished, White and Black Glazed Braid and White Fireproof.**

We can freely recommend this Wire for all inside wiring, from the fact that recent insulation tests made by reliable authorities show that it stands very high.

**PHILLIPS INSULATED WIRE COMPANY,**

Chicago Agents, ELECTRIC APPLIANCE CO. New York Office, 39 and 41 Cortlandt Street, Factory, PAWTUCKET, R. I.

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## Chicago General Fixture Co.,

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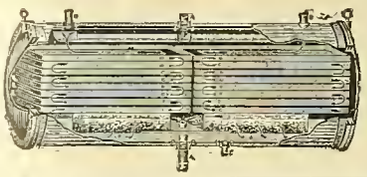
## Stilwell's Patent Live Steam-Feed Water Purifier.



**Removes all Impurities.**

Entirely prevents *scale* in Steam Boilers. Catalogue on application.

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**FREE APPARATUS.**

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One-twentieth of a cent a mile, on the **Imperial Wheel.** Cheaper than other bicycles because less repairs are needed. Our convincing catalogue for the asking.

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By our correspondence method. Thorough instruction, with FREE APPARATUS. Moderate terms. Diplomas awarded. Catalogue free. **Scientific Machinist Co.,** 90-91 Atwater Bldg., Cleveland, O.

## FOR SALE.

One 50-light Standard arc 2,000 C. P. dynamo; one 50-light American arc 2,000 C. P. dynamo; one 45-light T.-H. arc 1,200 C. P. dynamo; about twenty (20) smaller arc machines; all machines have a full complement of lamps; one 2,500-light National alternator; one 750-light Westinghouse alternator; one 750-light Slattery alternator; one 500-light T.-H. alternator; all station instruments are with machines. Hard time prices.

**CHAS. E. GREGORY CO.,**
47 and 49 South Jefferson Street, CHICAGO, ILL.

## For Sale at a Bargain.

Five H. P. 220 Volt Motor. Purchaser can see it run. Guaranteed to be in first class condition. Write for particulars.

**CUSHING & MORSE,**
**225 Dearborn Street, Chicago.**

## SITUATION WANTED.

Young man (27), strictly sober and steady, with first-class references, would engage as electrician, superintendent or engineer of electric light plant anywhere in U. S., Canada or Mexico. Can erect his own steam and electric plant, all out and inside wiring, direct or alternating current, arc or incandescent. Address **"Philadelphia,"**

Care WESTERN ELECTRICIAN,
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## WANTED.

A man engaged in electrical trade to take the agency on commission of rubber tapes for insulating purposes. Address

**MANUFACTURER,**
Care WESTERN ELECTRICIAN,
6 Lakeside Building, Chicago.

## $80.00 PER MONTH

Secures a practical electrician who can act as superintendent of small electric railway. Can do all general repairing, including armature and field winding. Can fully equip an electric railway. Address *"R. K."*

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## THE GOUBERT

**Feed-Water Heater.**

**Specially Adapted to CONDENSING ENGINES and in use in the largest ELECTRIC LIGHTING and ELECTRIC RAILWAY PLANTS in the United States.**

**ALL SIZES, 50 to 5,000 H. P.**

Send for Catalogue.

Agencies in all Principal Cities.

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**GOUBERT MFG CO.,**
14 and 16 Church St., cor. Cortlandt, - NEW YORK.

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**The Peer of All.**
**The "Far-Away Talker."**

*Beware of Infringing or of Using Infringing Instruments.*

The D'Unger Telephone (its reputation as the best instrument ever constructed now fully established) is the *only* self-cleaning speech sender in the world; the *only* instrument in which the *power of the voice* is increased; the *only* instrument in which *the electric current is intensified* by the action of the voice; the *only* instrument in which *the voice-wave is reduced.* No telephone can be built with these wonderful advantages *without the use of a lever.* The D'Unger Long-Distance Telephone Company has *the sole and exclusive right to use a lever in telephones—remember that.*

These instruments are supplied to exchanges and toll lines on a small annual royalty. They cannot be had on any other terms.

*The D'Unger Long-Distance Telephone Company* owns the *first* and *only undisputed patent for an All-Carbon Multiple-Contact Telephone in this country.* All persons who assert that this company's patents infringe upon any other patents are guilty of premeditated falsehood.

Address all letters to **R. D'Unger,** Manager, Palmer House, Chicago, Ill.

## The Dow Adjuster

Is a thoroughly reliable mechanism for instantly raising or lowering an electric light. The lamp can be placed at any height as easily as a window shade can be raised or lowered.

Manufactured Solely by

**Dow Adjuster Co,**
Box 210, Braintree, Mass.
Send for Circular.

PORCELAIN MANUFACTORY.

Empire China Works.

144-156 GREENE ST. STATION G

BROOKLYN, N.Y.

GENUINE HARD PORCELAIN, CUT-OUTS, SWITCH BASES, INSULATORS &c

## Miamisburg Electric Co.,

Miamisburg, O.

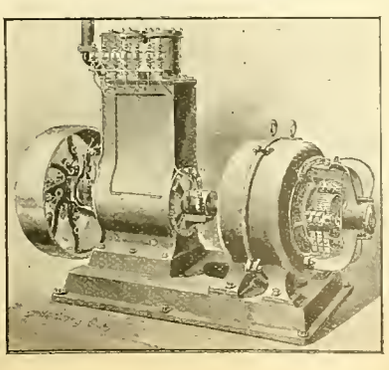
### IMPERIAL DRY BATTERY.

Guaranteed the best Dry Battery ever made. Internal short circuiting or local action is eliminated. Will not deteriorate when not doing work. Will hold its first value over long periods of time. Internal resistance small; high and constant, E. M. F. Will not run down or die on the shelf. No bursting of seals or oozing of salts from the top.

### Burnley Cartridge Battery.

Cartridge or Porous Cups made of especially prepared paper. One-half the size and one-third the weight of other porous cups. Guaranteed to be equal to any Salammoniac battery made. The cheapest battery now on the market.

**A 1 Batteries Guaranteed.** **Send for Catalogue.**



## LUNDELL DYNAMOS AND MOTORS.

**Direct Current, Slow Speed, Iron Clad,**

In Sizes up to 30 Kilowatts.

Lundell Dynamos directly connected to any type of high speed engines.

For Lundell Dynamo and Motor catalogues, prices, etc., address the

**Interior Conduit & Insulation Co.**
44 Broad St., N. Y.

## PORTER & BUERDORF,

SALES AGENTS FOR

**DETROIT SYSTEM STREET R'Y MOTORS, Generators and Electrical Supplies.**

Storage batteries for traction work *sold with guarantee* of 20,000 miles without repairs. Installation of storage battery lighting plants a specialty

**Room 808, No. 21 Quincy St., Chicago.**


## TENDERS

—FOR—

## Electric Light Plant.

Tenders will be received by registered post only, addressed to Ald. W. T. Stewart, Chairman Committee on Fire and Light, Toronto, up to 11 o'clock A. M. of

**Saturday, the 1st of September, 1894,**

For the installation of a complete electric light plant for the

**CITY OF TORONTO, ONT.**

Separate tenders will be received for the various portions of the work, viz.:

1. Engine Equipment.
2. Counter Shaft and Pulleys.
3. Belting.
4. Boilers.
5. Pumps and Steam Piping.
6. Economizers.
7. Dynamos and Station, Electrical Apparatus.
8. Arc Lamps.
9. Poles and Overhead Circuits.
10. Mast Arms and Lamp Attachments.

Plans and specifications may be seen and forms of tender obtained at the office of the City Engineer on and after Saturday, the 11th of August, 1894.

Specifications for items Nos. 2, 3, 5, and 6 may be withheld until balance of apparatus is decided upon.

A Deposit, in the form of a marked check, payable to the order of the City Treasurer, for the sum of 2½ per cent. on the value of the work tendered for, must accompany each and every tender, otherwise they will not be entertained. All tenders must bear the *bona fide* signatures of the contractor and his sureties (see specifications) or they will be ruled out as informal.

The Committee do not bind themselves to accept the lowest or any tender.

W. T. STEWART.
Chairman Committee on Fire and Light.
Committee Room, Toronto, July 26th, 1894.

## TENDERS

**For Lighting the Streets of the City of Toronto.**

Tenders addressed to the undersigned will be received by registered post up to 12 o'clock noon of

**SATURDAY, SEPTEMBER 1st, 1894,**

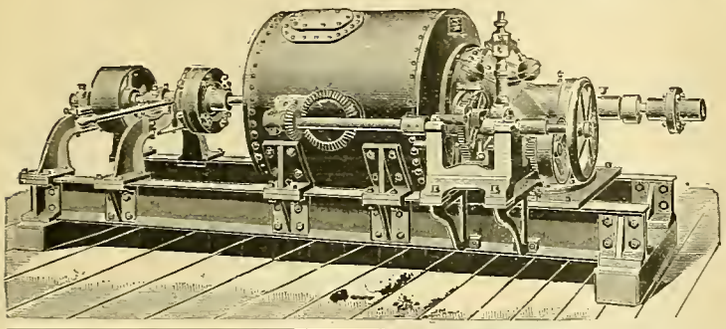
For the lighting of the streets, avenues, squares, and lanes of the City of Toronto with electric light and gas for a period of five years from the 1st of January, 1896. Specifications and forms of tender can be obtained upon application at the office of the Secretary of the Fire Department, Bay street, Fire Hall, on and after Wednesday, August 1st.

Cash deposit or marked check, made payable to the order of the City Treasurer for the sum of $3,000, must accompany each and every tender, together with the *bona fide* signatures of two responsible persons who will become sureties for the due fulfilment of the contract. The deposit accompanying the tender will be forfeited to the city in the event of the person or persons, whose tender is accepted, failing to execute the contract or give satisfactory sureties for the due fulfillment of the same. Deposite of unsuccessful tenderers will be returned

Lowest or any tender not necessarily accepted.

W. T. STEWART.
Chairman Committee on Fire and Light,
City Clerk's Office, Toronto, July 27th, 1894.

# VICTOR TURBINE WATER WHEEL.



Cylinder or Register Gate—Close Regulation and High Efficiency at Full and Partial Gate.

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter**, being **double the power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

***SEND FOR CATALOGUE AND PARTICULARS.***

The accompanying engraving represents a single 10-inch Victor Turbine on horizontal shaft to develop 36 H. P. under 38 feet head. Arranged with 12-inch Worrell Friction Coupling at one end to disconnect pulley.

We are now prepared to furnish Victor Turbines, either single or in pairs, on horizontal shafts, and where the situation admits of their use we recommend them.

**The Stilwell-Bierce & Smith-Vaile Co., Dayton, O.**

## CONVERGING ROADS.

Road to Long Life-ville.

Road to High E. M. F.-ville.

Road to Uniform Current-ville.

LAW DOUBLE CYLINDER CELL.

Road to Just What You Want-ville.

Road to Low L. R.-ville.

Road to Economy-ville.

LAW BATTERY COMPANY,

85 JOHN ST., NEW YORK.

Various other Law Cells, Zincs, Carbons, Sal Ammoniac, Etc.

*The Standard Open Circuit Batteries of the World.*

SEND FOR CIRCULAR AND PRICES.

**THE LECLANCHE BATTERY CO.,**

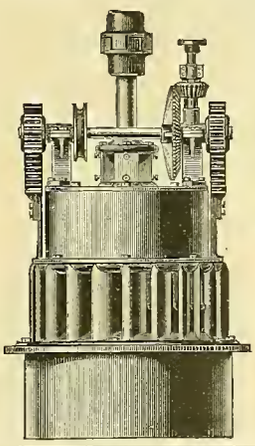
*111 to 117 East 131st St., N. Y.*

## GRAPHITE SPECIALTIES

**FOR ELECTRICAL USES:**

**Graphite Rods of Various Lengths, from 1-5 Ohm to 100 Ohms Resistance to the Inch. Graphite Boxes and Crucibles, Resisting Heats of 4,000 Degrees. Inquiries Gladly Answered.**

**JOS. DIXON CRUCIBLE CO., Jersey City, N. J.**



## THE McCORMICK TURBINE,

On Vertical or Horizontal Shaft, Especially Adapted for Electric Work.

**Gives more power as to diameter with a higher percentage of useful effect than any other water-wheel heretofore made.** All sizes, right and left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume.

Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers, will find it to their interest to confer with me, **as I am willing to guarantee results where others have failed, no matter what make of turbine has been in use. STATE REQUIREMENTS AND SEND FOR CATALOGUE.**

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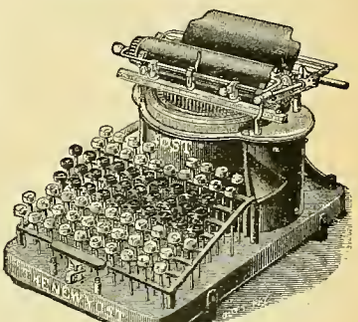

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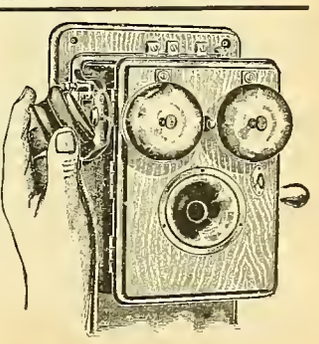

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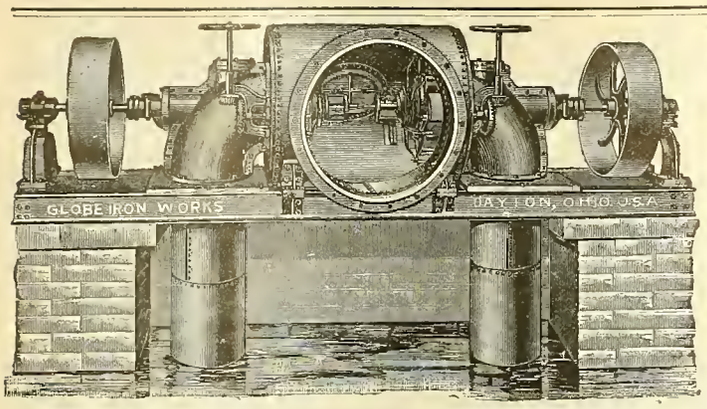


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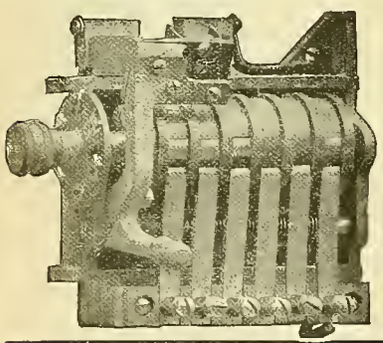

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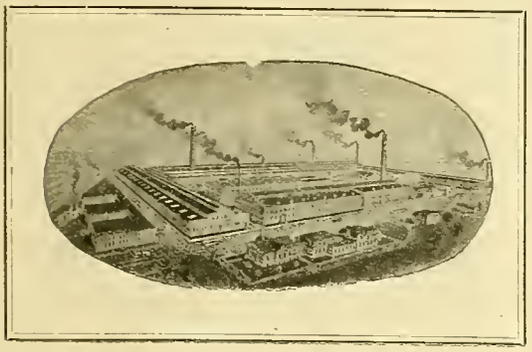

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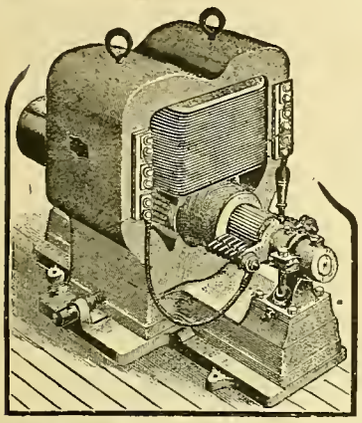

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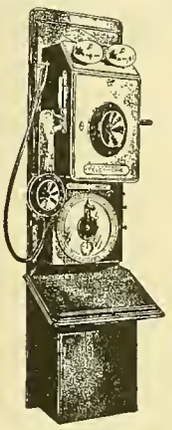

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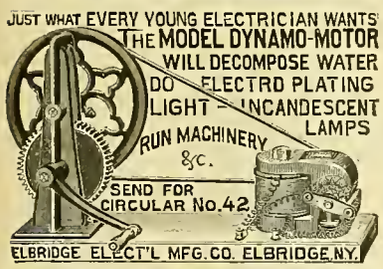


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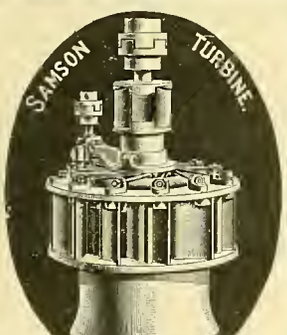


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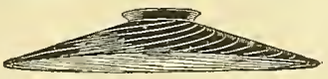

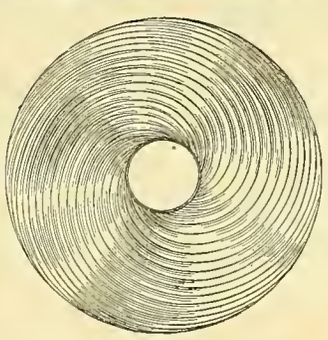

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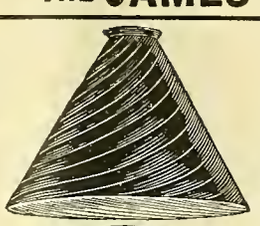

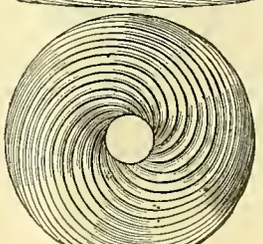

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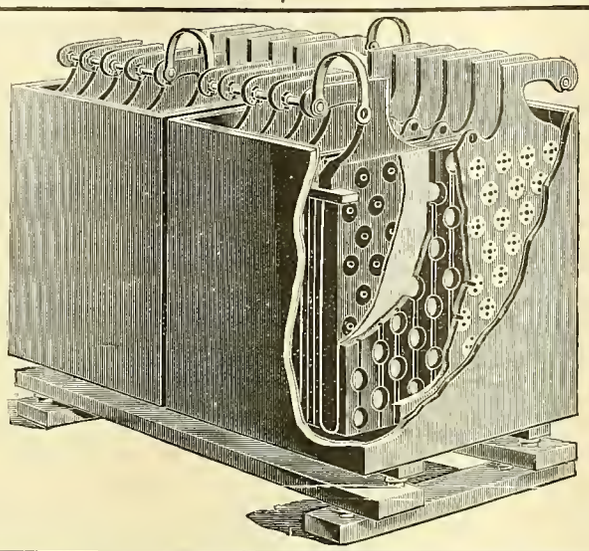

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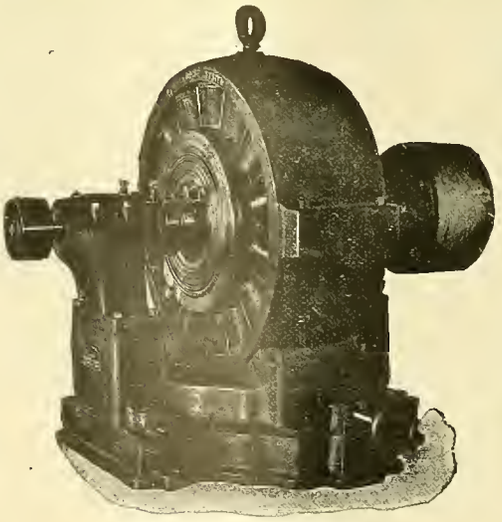

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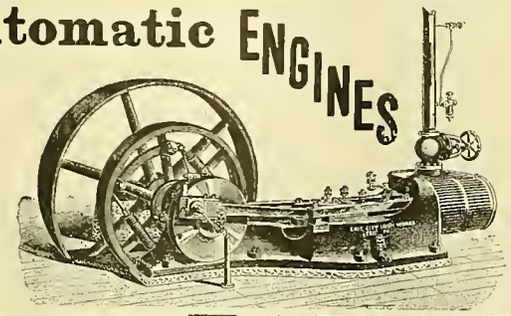

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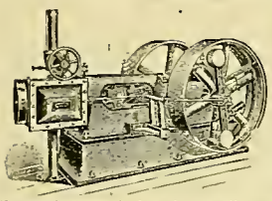

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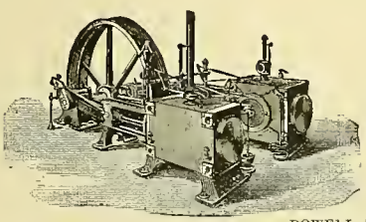

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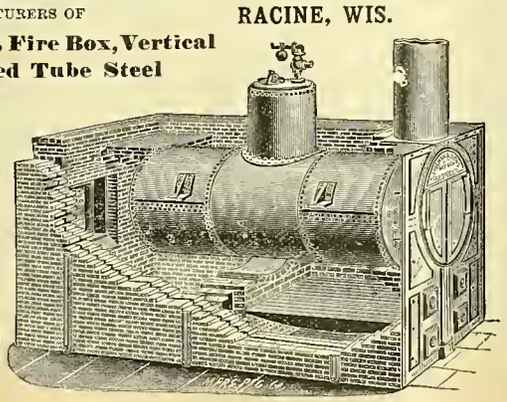

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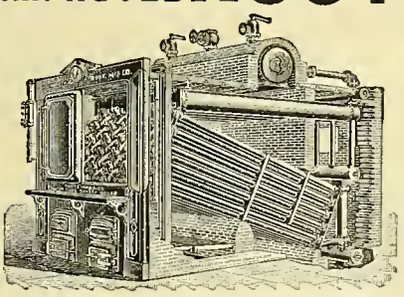

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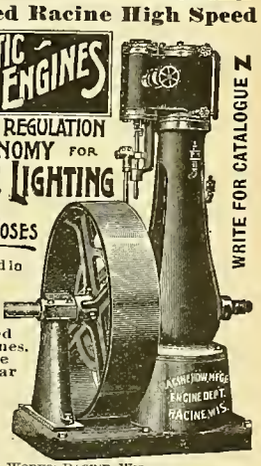


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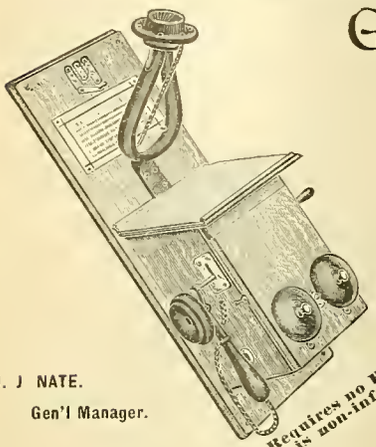

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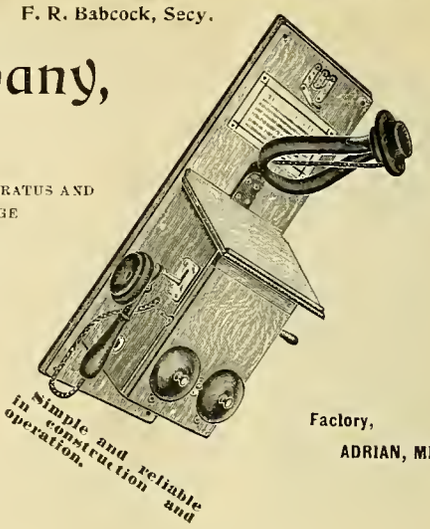

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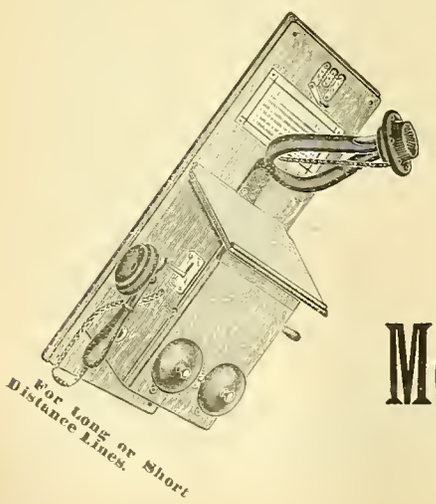

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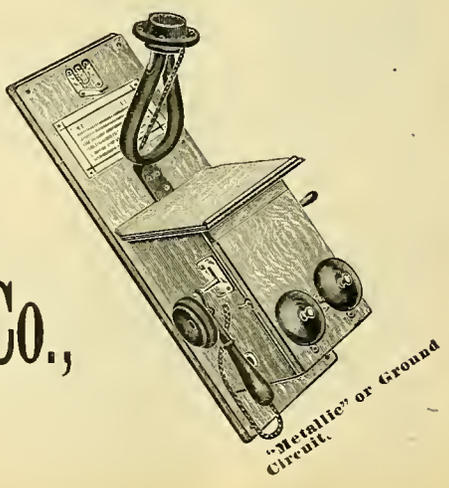

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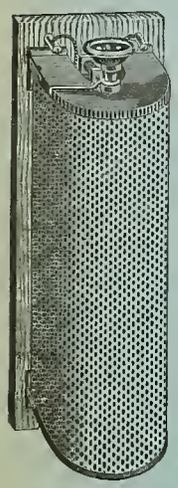

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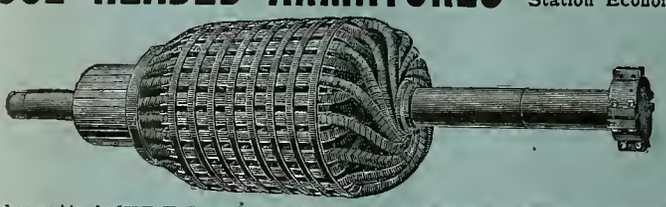

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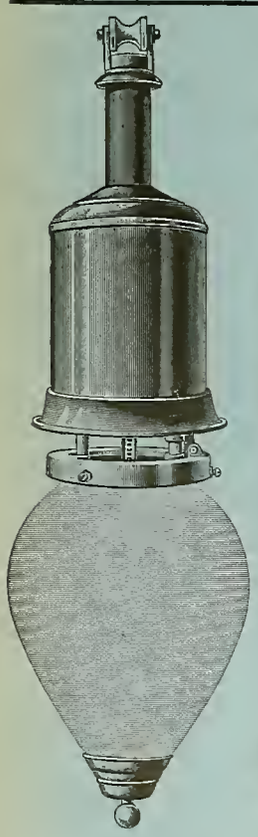

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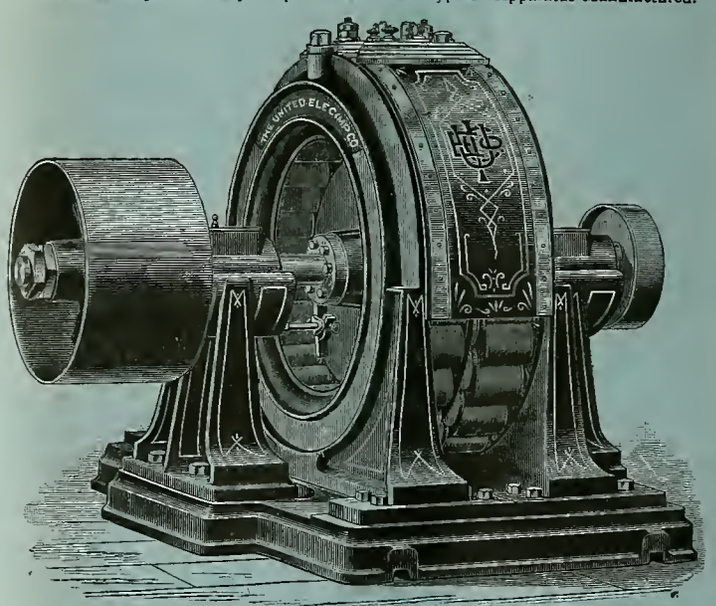

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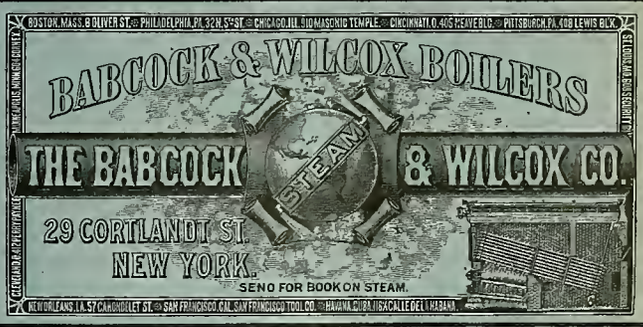


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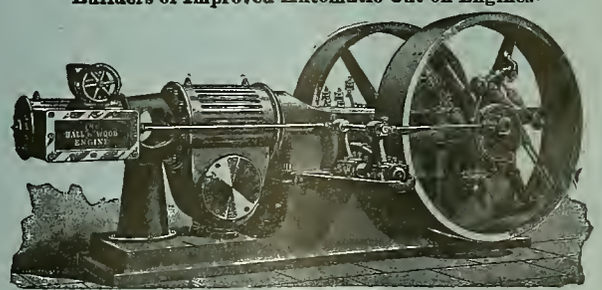


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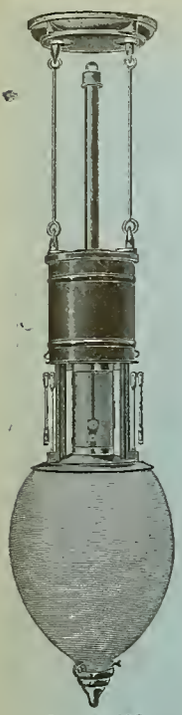

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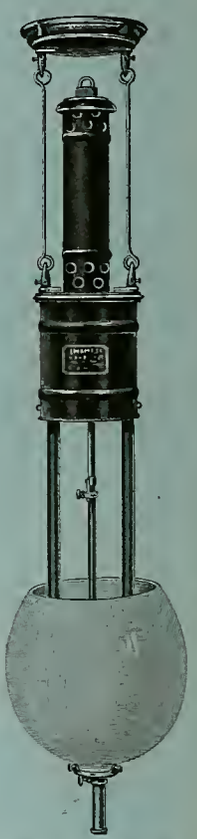

Thomson '93 Standard Lamp for Incandescent or Railway Circuits.

# GENERAL ELECTRIC COMPANY,

MAIN OFFICE, SCHENECTADY, N. Y.

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Cleveland, Ohio, 510 Cuyahoga Building.
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For all business outside the United States and Canada—Thomson-Houston International Electric Co., Schenectady, N. Y. and 44 Broad St., New York. For Canada—Canadian General Electric Co., Ltd., Toronto, Canada.

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## CLASSIFIED LIST.


**Accumulators.**
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Cons. Electric Storage Co.
Electric Storage Battery Co.
Porter & Buerdorf.

**Adjusters, Lamp.**
Dow Adjuster Co.

**Annunciators.**
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Central Electric Co.
Electric Appliance Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Washington Electric Co.
Western Electric Co.

**Belting.**
Shultz Belting Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co., The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Fulton Steam Boiler Wks.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electrician Publishing Co.

**Brushes.**
Partridge Carbon Co.
Wirt, Chas.

**Burglar Alarms.**
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric.** (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Chicago Ins. Wire Co.
Cushing & Morse.
Eastern Electric Cable Co.
Hill, W. S. Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

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Central Electric Co.
General Electric Co.
Metropolitan Electric Co.
Partridge Carbon Co.
Western Electric Co.

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Consolidated Car-Heating Co.

**Castings.**
Dutcher Co., J. A. & P. E.

**Clocks, Electric.**
Self-Winding Clock Co.

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Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

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Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Muncie Elec. Mfg. Co.
Washington Electric Co.
Wirt, Chas.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Roberts & Co., E. P.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Chicago Ins. Wire Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Chicago Cross Arm Co.
Electric Appliance Co.
Hubley Mfg. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Sioux City Brass Works.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Electric Railways.**
Brush Electric Co.
General Electric Co.
Hubley Mfg. Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Cameron & Gillett.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Roberts & Co., E. P.
Rushmore, S. W.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng. & Iron Wks.
Weston Engine Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Central Electric Co.
Interior Conduit & Ins. Co.
Muncie Elec. Mfg Co.

**Fibre**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. Supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Hubley Mfg. Co.
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Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Palmer Bros.
Porter & Buerdorf.
Sioux City Brass Works.
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**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Hubley Mfg. Co.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.
Hubley Mfg. Co.

**Hard Rubber Goods.**
Hutler Hard Rubber Co.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Hunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
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Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Vulcanized Fibre Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Ins. Wire Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Hubley Mfg. Co.
Independent Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Mather Electric Co.
Metropolitan Electric Co.
New York & Ohio Co.
United Elec. Imp. Co.
Westinghouse Elec. & Mfg. Co.

**Lightning Arresters.**
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Wirt, Chas.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery.**
Bliss Co., E. W.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

**Motors.**
Bolgiano Mfg. Co.
Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
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Royal Electric Co.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co.

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Garlock Packing Co.

**Paints.**
Standard Paint Co.

**Phosphor Bronze.**
Phosphor Bronze Sm. Co. Ltd

**Platinum.**
Baker & Co.

**Poles.**
Brownlee & Co.
Morris, Tasker & Co.
Nuttall Co., R. D.

**Porcelain.**
Empire China Works.
Chicago Gen'l Fixture Co.
General Electric Co.
Phœnix Glass Co.

**Publishers, Electrical.**
Electrician Publishing Co.

**Push Buttons.**
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.

**Rheostats.**
General Electric Co.
Rushmore, S. W.

**Sal Ammoniac**
Hayden-Booker Mfg. Co.
Innis & Co.
Klipstein, A. & Co.
Law Battery Co.

**Second-Hand Electrical Machinery.**
Gregory, Chas. E. Co.
Rushmore, S. W.

**Silk Braid.**
Boston Braid Mfg. Co.

**Slate.**
Independent Electric Co.

**Speaking Tubes.**
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.

**Speed Indicators**
Whitney Elec. Instrument Co

**Steam Heating.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Steam Pumps.**
Worthington, Henry R.

**Storage Batteries.**
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric Storage Battery Co.
Porter & Buerdorf.

**Stoves, Electric.**
Consolidated Car-Heating Co.

**Street Cars.**
Brill, J. G. Co.

**Tapes, Insulating.**
American Electrical Works.
Central Electric Co.
Cushing & Morse.
Chicago Ins. Wire Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Western Electric Co.

**Telephones,**
D'Unger Long Dist. Tel. Co
Harrison Int. Telephone Co.
National Telep. Mfg. Co.
Palmer Bros.
Western Electric Co.
Western Tel. Const. Co.

**Transformers.**
General Electric Co.
Hornberger Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Trucks, Electric Car.**
General Electric Co.
Westinghouse El. & Mfg. Co.

**Turbine Wheels.**
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

**Type-Writing Machines.**
Yost Writing Machine Co.

**Universities.**
Cor. School of Industrial Sciences.
Correspondence School of Technology.
Scientific Machinist Co.

**Varnishes.**
Standard Paint Co.

**Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Water Wheels.**
Leffel & Co., Jas.
Smith, S. Morgan.

**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Electric Appliance Co.
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.

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8, 10 and 16 Candle Power Lamps, 22 Cents. 20 and 25 Candle Power Lamps, 27 cents.
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WITH DISCOUNTS VARYING ACCORDING TO QUANTITIES ORDERED.

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**3rd. All lamps have uniform molded glass bases, and can be used in the following sockets: Edison, Brush-Swan, United States, Thomson-Houston and Sawyer-Man.**
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## PITTSBURGH, PA.

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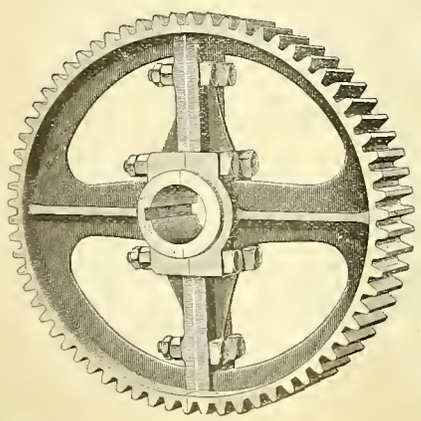
J. R. McGINLEY, Vice-President.
F. S. MARTIN, Superintendent of Works.

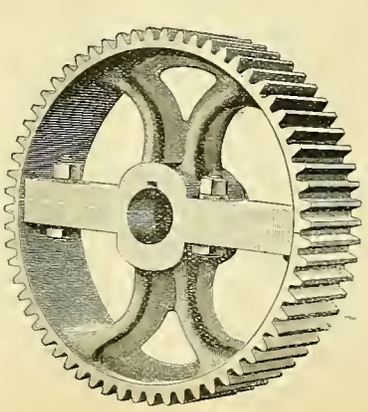


MANUFACTURERS OF
**Electric Railway Supplies.**

**GEARS, PINIONS, BEARINGS, TROLLEYS, TROLLEY WHEELS AND HARPS.**

THIS IS THE IMPROVED NUTTALL TROLLEY.

TRY IT ONCE, AND YOU WILL WANT NO OTHER.



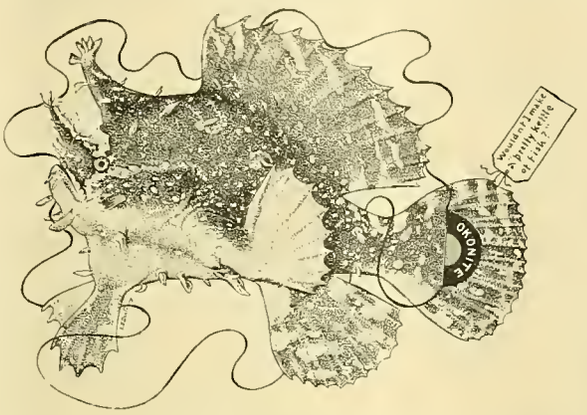
**The largest and most prosperous street railway companies in the country are using our supplies, and they prefer them to all others on account of greater strength and durability. Correspondence solicited.**

CHAS. J. MAYER, 600 Betz Building, Philadelphia, Pa., Middle States Sales Department.
CHAS. N. WOOD, 180 Summer St., Boston, Mass., New England States Sales Department.
STANDARD RY SUPPLY CO., Monadnock Block, Chicago, Ill., N. W. States Sales Department.
A. S. PARTRIDGE, Bank of Commerce Building, St. Louis, Mo., S. W. States Sales Department.
CHAS. A. CAVAGNA, Neave Building, Cincinnati, Ohio, Central States Sales Department.

no matter what sort of

## Queer Fish

you tangle up with Okonite wire, it never loses its identity. There are certain distinguishing marks, certain inherent qualities of insulation which make it conspicuous wherever used.




There have been cases where the workmen, with an abiding faith in Okonite, mixed a little of it with a great deal of other, and inferior, insulation, hoping with that little to save the whole installation from the wrath of the inspector. While it is no doubt true that Okonite would cover a multitude of sins in this manner, *we do not approve of the method.*

Let every fish wiggle its own fins.

**What we want is orders** for the simon pure, unadulterated **Okonite.**

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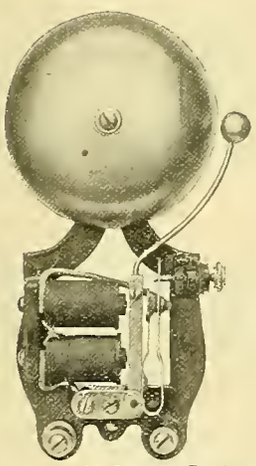


**This is the Contact Protected Dust-Proof Bell.**

## Here is a Bell

That will meet the instant approval of every Contractor or Bell-fitter who has had to contend with the numerous difficulties in the way of assuring his customers uninterrupted service.

Nothing is more annoying than to be called a long distance just to chase a bug out of the contact-points, or to blow away a speck of dust. Various insect-proof frames and boxes have been designed, but in each the really *vital* point was left unprotected. **In this bell** *the contact points are sealed.* No bug, no dust or other obstruction can prevent ringing. We have this bell in various sizes. Also a full line of House Goods Specialties, Annunciators, Batteries, Insulated Wires, Push Buttons and Construction Tools.

*Orders and correspondence given prompt attention.*

BRANCHES:
St. Louis: Southern Electrical Supply Co.
Kansas City: Gate City Electric Co.

**Central Electric Company,**
173-175 Adams Street, CHICAGO.

GENERAL WESTERN AGENTS

Okonite Wires, Interior Conduit, Lundell Fans, Helios Arc Lamps, Washington Carbons, Carpenter Enamel Rheostats.

# HAVE YOU INVESTIGATED

**The merits of the Stanley Two-Phase System of Alternating Current Apparatus?**

**It will pay you to do so, as its earning capacity is much greater than anything else on the market.**

Light and Power can be supplied by this system from the same generator and circuit.

## THE GENERATOR

**Is superior to all others in efficiency, simplicity, durability and inherent regulation.**

## THE MOTORS

**Are self starting, take current in proportion to their load, substantially as direct current motors do, and are more simple, durable and convenient to use than direct current motors.**

## THE STANLEY TRANSFORMERS

**Excel all others in efficiency, regulation, convenience, safety and durability. We insure them for a term of years at a small premium.**

## STANLEY ELECTRIC MFG. CO., PITTSFIELD, MASS.

**Western Office, 307 Dearborn St., Chicago, Ill.**

# We Want Western Business.

# LA ROCHE ALTERNATORS.

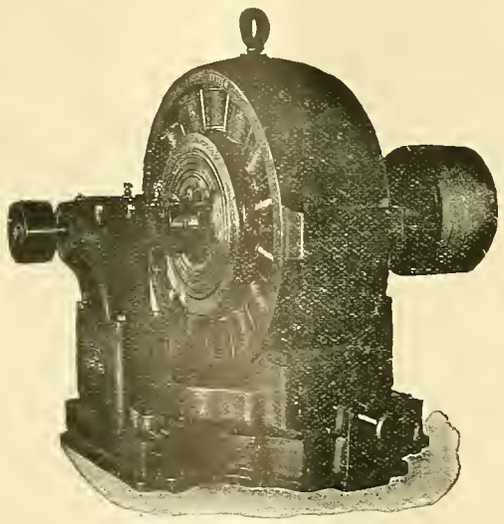
MANUFACTURED IN SIZES FROM

*25 to 5,000 Lights,*

SINGLE OR MULTIPHASE.

Direct Connected Dynamos.

Direct Current Generators.



1,000 Light Alternator.

## La Roche Electric WORKS, PHILADELPHIA, PA.

DISTRICT OFFICES:

New York, Boston, Knoxville, Cincinnati, Pittsburg, San Francisco, Chicago, St. Louis, Mobile.

**HOOD & OSBURN, 239 La Salle Street, CHICAGO.**

**OWEN FORD, Rialto Building, ST. LOUIS, MO.**

# A GREAT REDUCTION IN PRICES ON OUR

# REFLECTOR PLATE ALTERNATING LAMP.

## We are Heavily Stocked with New Styles and Designs.

We claim for our lamp a better distribution of light than can be obtained from any other alternating lamp. We obtain this result by means of our reflector plate.

The only lamp that has a legal right to use a reflector plate. We guarantee 50 per cent. more effective light than can be obtained from any other alternating lamp.

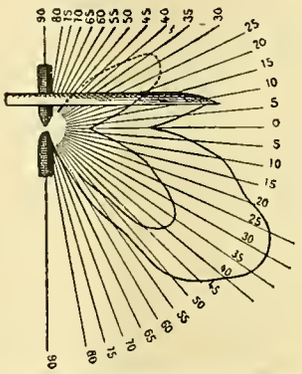


Diagram showing distribution of light with and without a reflector plate.

Our phenomenal sales are due to the reflector plate.

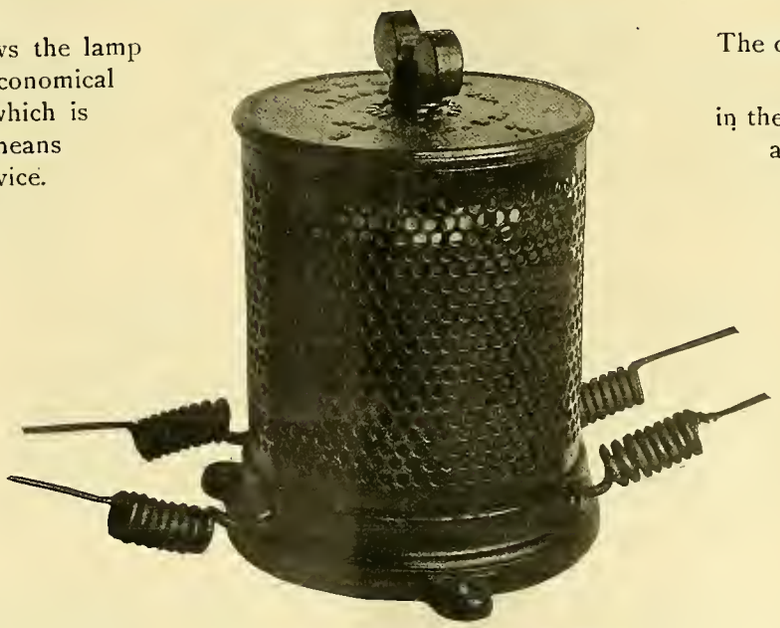
No alternating lamp can be a success without it.

We obtain more economy from our lamp than can be obtained from any other alternating lamp in the market. We do this by means of the

## SPENCER ECONOMY COIL.

The only Coil that allows the lamp to burn at its most economical voltage (28 volts), which is accomplished by means of its starting device.

The only adjustable **Economy Coil** in the market. It requires no resistance nor additional switch.



**Complete Installations for Inside and Street Lighting Purposes.**

**Direct Current Lamps.**
**Photo-Engraving.**
**Theatrical.**

## CARBONS.

*To Users of Helios Lamps:* August 15th.—Yearly contracts can be made for the **Helios Carbons** at greatly reduced prices. We can supply unlimited orders.

# Helios Electric Co.,

## 1306, 1308 and 1310 Filbert St., Philadelphia, Pa., U S. A.

Eastern Agents: STANLEY ELECTRIC MFG. CO., Pittsfield, Mass.
Western Agents: CENTRAL ELECTRIC CO., Chicago, Ill.
Southwestern Agents: ST. LOUIS ELECTRICAL SUPPLY COMPANY, St. Louis, Mo.
Canadian Agency: CANADIAN GENERAL ELECTRIC COMPANY, Toronto, Canada.

New York City Agents: GLOBE ELECTRICAL SUPPLY & CONSTRUCTION CO, Vandam and Greenwich Streets.
Pacific Coast Agent: SAMUEL H. TAYLOR, 195 Crocker Bldg., San Francisco, California.
MOUNTAIN ELECTRIC CO., Denver, Colo., Agents for Colorado, Utah, Wyoming, New Mexico and Arizona.

# THE C & C ELECTRIC COMPANY

MANUFACTURERS OF

## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

General Office:
143 Liberty Street, NEW YORK.

Works: CARWOOD, N. J.
on CENTRAL R. R. of N. J.

BRANCH OFFICES: CHICAGO, 1020 and 1021 Monadnock Building. BOSTON, 63 Oliver St. CLEVELAND, Cuyahoga Building. PHILADELPHIA, 633 Arch St.

## PROTECT YOUR MOTORS

BY USING THE

## HILL PATENT SELF-LOCKING STARTING SWITCH.

No possible chance for an accident, as the Switch cannot be closed until the resistance is all in.

CHEAP. COMPACT. DURABLE.

MADE ONLY BY THE

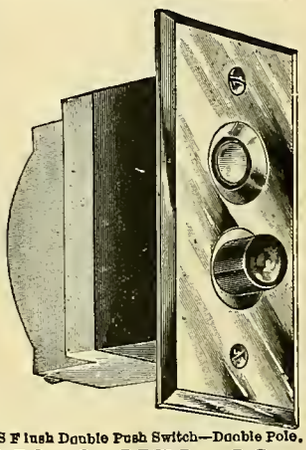
## W. S. Hill Electric Co.,

133 Oliver Street, BOSTON, MASS.

SEND FOR CIRCULAR AND PRICE LIST.

NEW YORK, ELSON & BREWSTER, 143 Liberty Street.
CHICAGO, CENTRAL ELECTRIC CO.

## C-S SPECIALTIES.



C-S Flush Double Push Switch—Double Pole.

### C-S Flush Double Push Switch.

Single Pole—Double Pole—Commutation; 3 Wire, 4 Wire.

### C-S Flush Key Switch.

Single Pole—Double Pole—3 Wire.

### C-S Flush Automatic Switch.

Single Pole.

ELECTRICALLY
MECHANICALLY
ARTISTICALLY **PEERLESS.**

## THE CUTTER ELECTRICAL & MFG. CO.,

*27 So. 11th Street, Philadelphia, Pa., U. S. A.*

STEPHEN B. ELKINS, Prest. PATRICK EGAN, Sec'y. H. J. HANFORD, Gen'l Mgr.

## The Harrison International Telephone Co

AGENTS' TERRITORIES NOW BEING ALLOTTED.

WRITE AT ONCE.

WHAT MONEY CAN EARN AND THE PEOPLE SAVE BY MEANS OF THE

### Harrison International Telephone.

**We either sell our telephones outright or lease them for a term of years.**

This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Patent No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete electric speaking telephone operated by battery; and owns Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

Prospectuses furnished by addressing the Company at their offices,

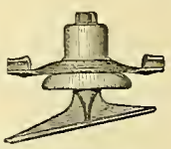
Offices, Chamber of Commerce Bldg., Chicago.

## "Monarch" Insulating Material.

A hard, black composition, which is not liable to crack or break during service, or alter its form under ordinary changes of temperature. It is moulded to exact shape, and is suitable for switch-blocks, sockets, bushings, and other parts requiring accuracy of dimension and finish.

## TROLLEY LINE INSULATORS.

Insulated with Moulded Mica, and designed with special reference to their strength, durability and high insulating qualities.



**VULCABESTON** Heat-Proof Insulation.

## H. W. JOHNS MFG. CO.,

New York, Philadelphia, Boston. *240 and 242 Randolph Street, CHICAGO, ILL.*

MARO S. CHAPMAN, Pres. THOMAS C. PERKINS, Vice-Pres. JOHN L. BUNCE, Sec'y and Treas. TH. GONET, Supt.

# THE MATHER ELECTRIC COMPANY,

## Manchester, Conn.

## Power Generators for Lighting and Railway Purposes.

## Complete Station Equipments.

Mather Apparatus for sale exclusively in their respective territories by the following well-known and reliable Contractors:

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H. B. COHO & CO, 203 Broadway, New York: New York City, Brooklyn and vicinity and New Jersey.
G. M. ANGIER & CO., 116 Bedford St., Boston, Mass.: New England.
S. N. BLAKE, Elmira, New York: Northern and Western New York.

Solid and Stranded Wires.

Cables and Switch Cords.

FOR

ALL WORK REQUIRING THE

Highest Insulation

—USE—

# PARANITE

IT HAS A

## PERFECT RECORD.

WRITE US FOR SPECIAL PRICES.

**AGENCIES:**

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GATE CITY ELEC. SUPPLY & CON. CO., Atlanta.
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SOUTHERN ENGINEERING CO., Louisville.
ELECTRICAL ENGINEERING CO., Minneapolis.
W. T. OSBORN & CO., Kansas City.

Eastern Sales Department:
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BOSTON.

New York Office,
32 FRANKFORT STREET.

Indiana Rubber & Insulated Wire Co., Manufacturers, Marion, Ind.

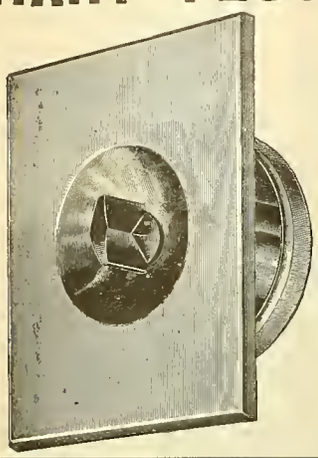
# Electric Appliance Co.,

General Western Agents,

242 Madison Street, CHICAGO.

ELECTRICAL SUPPLIES.

# HART FLUSH SWITCHES.



5 and 10 Ampere Single Pole.
10 Ampere Double Pole.
10 Ampere Three-way.

The Only Snap Switch that has
**PROVEN A SUCCESS.**

**For Sale by All Supply Houses.**

## The Hart & Hegeman
MANUFACTURING CO.,
HARTFORD, CONN.

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OCTAGONAL PINE POLES,
NORWAY PINE CROSS-ARMS,
WHITE OAK PINS.
It will pay you to get our prices.
BROWNLEE & CO., - Detroit, Mich.

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PURE
## SAL-AMMONIAC.
Guaranteed Over 99 Per Cent. Fare.
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## The Wirt Dynamo Brush.
Suitable for all Incandescent Dynamos, Plating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.
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## PORTER & BUERDORF,
SALES AGENTS FOR
DETROIT SYSTEM STREET R'Y MOTORS, Generators and Electrical Supplies.
Storage batteries for traction work *sold with guarantee* of 20,000 miles without repairs. Installation of storage battery lighting plants a specialty
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## ROYAL ELECTRIC COMPANY,
MANUFACTURERS OF
# TRANSFORMERS,
Alternating and Direct Current Dynamos, Generators and Motors,
PEORIA, ILL.
*Agents Wanted. Write for Catalogue.*

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# WIRT INDICATORS.

I have purchased the Wirt Laboratory from the assignee of the Ansonia Electric Co., together with a large stock of Wirt Indicators; these instruments are all new and in first-class condition. They include indicators for direct and alternating current ranging from 10 to 1,000 amperes and from 2½ to 3,000 volts. While this stock lasts I will make extremely low prices. Apply to the undersigned or to your regular dealer

*CHARLES WIRT, 56 5th Avenue, Chicago, Ill.*

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**BINDERS**
For the WESTERN ELECTRICIAN,
**—$1.00.—**

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**PLATINUM**
For all Purposes.
Scrap and Native Platinum Purchased.
BAKER & CO., 408-414 New Jersey Railroad Ave., Newark, N. J.

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The Only Clocks Used in the W. U. Tel. Co. Time Service.

NO WINDING. CORRECTED HOURLY.

SELF-WINDING CLOCK CO.,
26 Broadway, NEW YORK.
*Clocks Sold. Clocks Rented.*

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# The BISHOP GUTTA-PERCHA CO.

THE BEST GRADES OF
## Wire and Cables
For under ground, under water, and all other conditions.
**Address 420-426 East 25th Street, - - NEW YORK.**
HENRY A. BRED, Secretary and Manager.

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# SAL AMMONIAC
(ELECTRIC BRAND)
## For Electrical Purposes
Guaranteed 98/99% and free of lead and iron. If you want the best quality ask your dealer for this brand. Imported by
**A. KLIPSTEIN & COMPANY, 122 Pearl St., New York.**

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# THE WORTHINGTON STEAM PUMP,
**Henry R. Worthington,**

NEW YORK, 86 and 88 Liberty St.
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CLEVELAND, 24 South Water Street.
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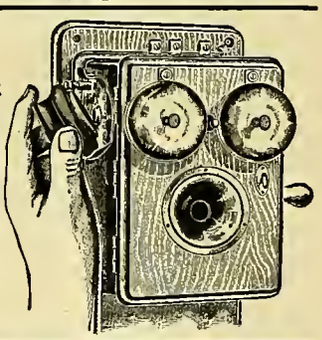
"NATIONAL" COMPOUND RECEIVER.

# THE "NATIONAL."

We make simply a business proposition. Buy two sets of our instruments and make your own tests. If satisfactory the way is open for more business, either in telephones or switchboards for exchanges.

**Our head telephones are largely used by Bell telephone operators.**

## NATIONAL TELEPHONE MFG. CO.,
620 (W) Atlantic Avenue, Boston, Mass.



"NATIONAL." Method of Placing Receiver in Holder.

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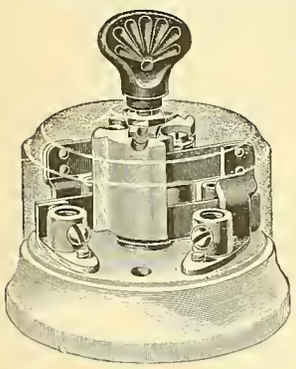

THIS IS A
# 5 AMPERE
DOUBLE POLE
## SNAP SWITCH,
MADE BY THE
**BRYANT ELECTRIC COMPANY,**
1532 MONADNOCK BLOCK, CHICAGO.

THOS. G. GRIER,
EDWARD R. GRIER,
Western Representatives.

**Factory: Bridgeport, Conn.**

*Sockets, Switches, Cut Outs, and Electrical Specialties. Good Goods and Prompt Shipments.*

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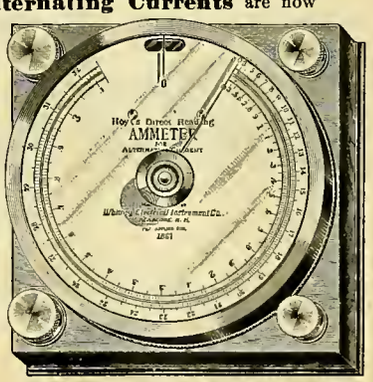
# Something New.

The **Hoyt Standard Ammeters** and **Voltmeters** for **Lamp** and **Meter** measurement on **Alternating Currents** are now ready for the market.

Send for our **1894 Catalogue** which contains the above and other new instruments of our manufacture.




## Whitney Electrical Instrument Co.,
**PENACOOK, N. H.**
Factories: Penacook, N. H.; Sherbrooke, P. Q., Can.
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New York City: Geo. L. Colgate, 186 Liberty St.
San Francisco, Cal.: California Electrical Works.
Toronto, Ont.: Toronto Electrical Works.
St. Louis, Mo.: St. Louis, Electrical Supply Co.
Little Rock, Ark.: The Brown Elec. & Mech'ry Co.

EUGENE F. PHILLIPS, Prest. W. A. HATHAWAY, Treas. W. H. SAWYER, Sec'y.

# AMERICAN ELECTRICAL WORKS,

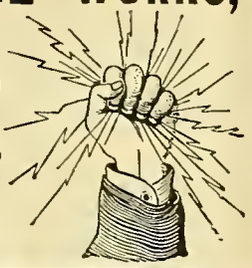
**PROVIDENCE, R. I.**

RAILWAY FEEDER AND TROLLEY WIRE,

ELECTRIC LIGHT LINE WIRE,

Incandescent and Flexible Cords,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



NEW YORK OFFICE, P. C. Ackerman, 10 Cortlandt Street.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works

# TELEPHONES!!

This company is manufacturing

**A Compound Magneto Telephone**

which it sells outright under a guarantee both as to efficiency and as against infringement of patents.

It talks as well over one hundred miles as any other Telephone talks over one mile.

This company is also prepared to fully equip Telephone exchanges, (furnishing everything from the telephone to the wire and pole). Private lines, Factory plants, etc., and do all kinds of construction work.

Send for circulars and price lists.

WESTERN TELEPHONE CONSTRUCTION CO.,

**539, 540 and 541 Monadnock Blk., Chicago, Ill.**

THE

# "CLARK" WIRE.

TRADE MARK.

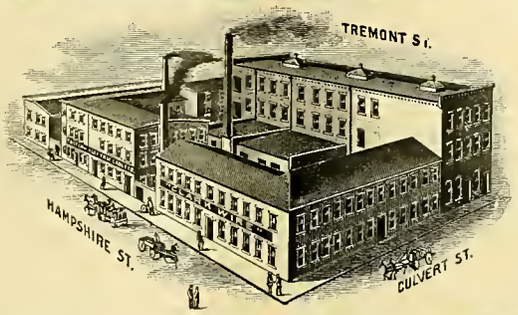
For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

**Western Agents,**

**GREAT WESTERN MFG. CO.,**

**Chicago, Ill.**




**In a Letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A Thoroughly Reliable and Desirable Wire in every respect."**

The Rubber used in insulating our Wires and Cables is especially chemically prepared, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat.

We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first class Insulated Wire.

We shall be pleased to mail Catalogues with Terms and Discounts for Quantities.

**EASTERN ELECTRIC CABLE CO.,**

**61 and 63 Hampshire St., Boston, Mass.**

HENRY A. CLARK, Treas. and Gen'l Mgr. HERBERT H. EUSTIS, Pres't. and Electrician

**Send for Catalogue.**

THE

**Consolidated Electric Storage Company,**

**BRUSH PATENTS,**

Licenses Granted.

EDISON BUILDING, NEW YORK.
DREXEL BUILDING, PHILADELPHIA.

HAYDEN-BOOKER MFG COMPANY,

Manufacturers of all kinds of

OPEN AND CLOSED CIRCUIT CELLS,

And Dealers in

Everything in the Battery Line.

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M. M. HAYDEN, President and Manager.

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# Subscribe for the Western Electrician.

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**INCORPORATED.**

Offices, 222-224 S. Third St., Philadelphia, Pa.

PASCAL IRON WORKS,
PHILADELPHIA.

DELAWARE IRON WORKS,
NEW CASTLE, DEL.

—Manufacturers of—

Boiler Tubes, Wrought Iron Pipes and Fittings.

ELECTRIC LIGHT and RAILWAY PIPE POLES A SPECIALTY.

**Chicago Agents,**
**Electric Appliance Company.**

# PHILLIPS INSULATED WIRE COMPANY,

PAWTUCKET, R. I.,

—MANUFACTURERS OF—

## "O. K." INSULATED WEATHERPROOF WIRE

For Electric Railway and Electric Light Work.

Superior Quality. Perfect Insulation. Handsome Finish,

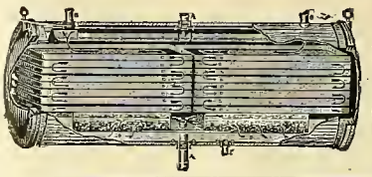
**New York Office, 39 and 41 Cortlandt St.**

# Electric Supplies
AND
# FIXTURES
AT
# RIGHT PRICES!

SEND FOR CATALOGUE.

## Chicago General Fixture Co.,
169 ADAMS STREET, CHICAGO.

## Stilwell's Patent Live Steam-Feed Water Purifier.



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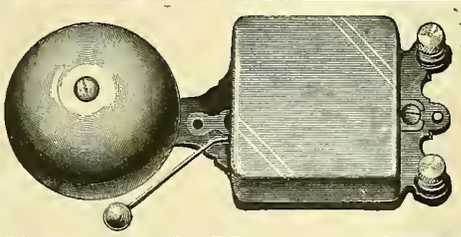

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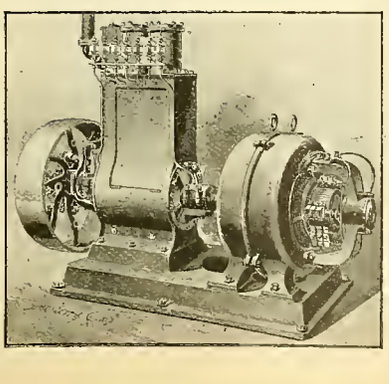

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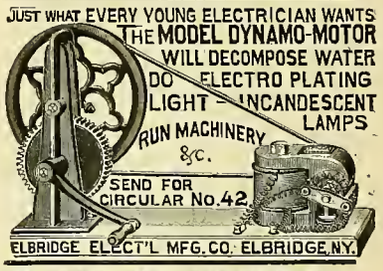


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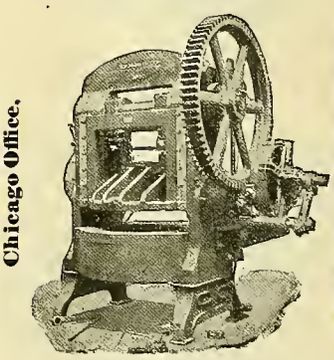

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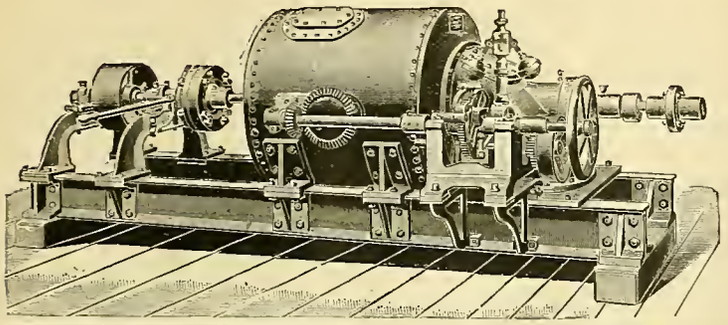

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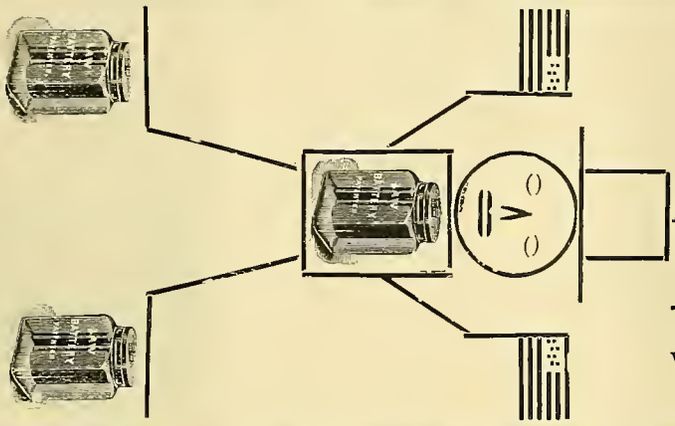

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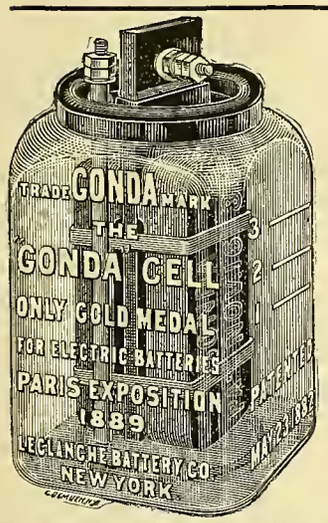


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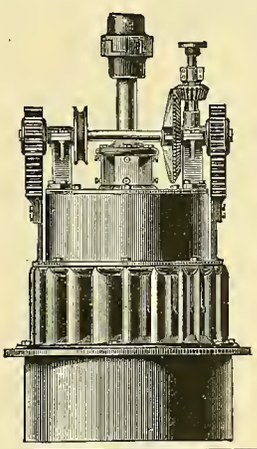

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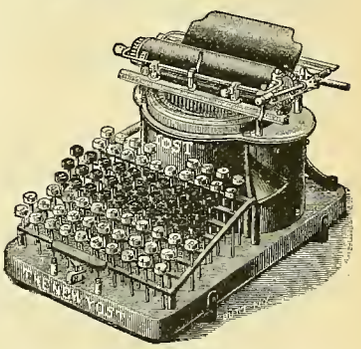

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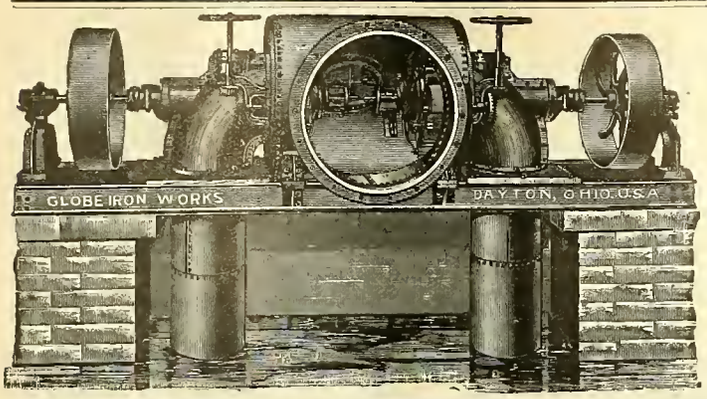


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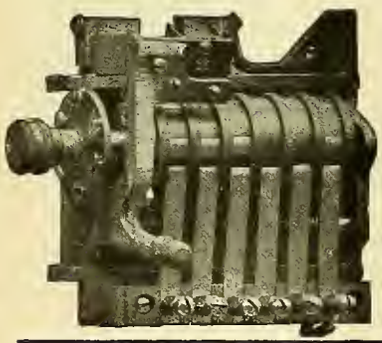

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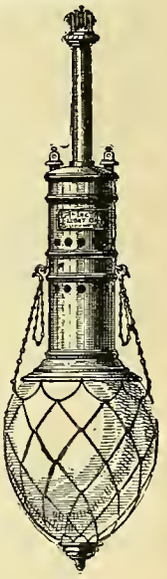

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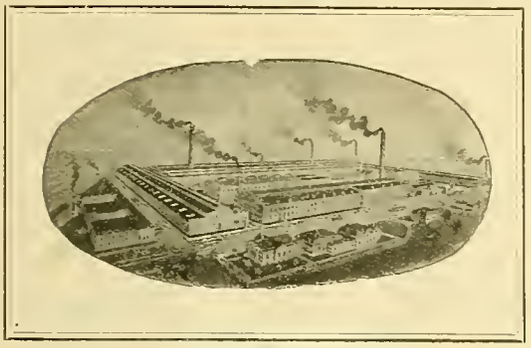

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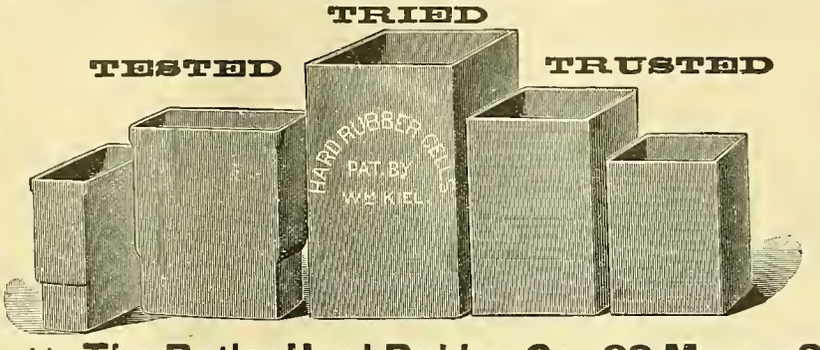


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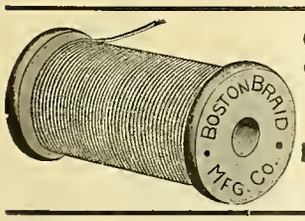


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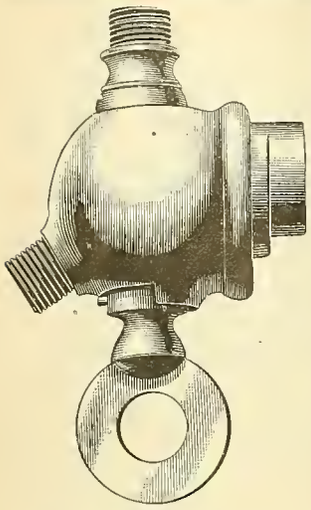

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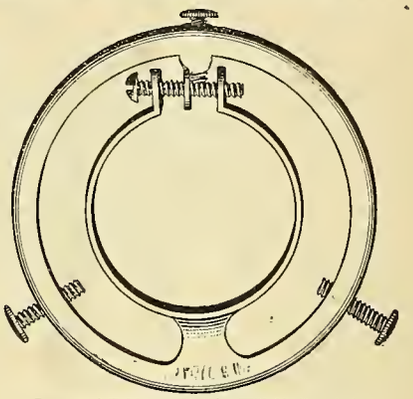

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I find the amount of:

| | | | | | |
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| Ammonium Chloride | contained | therein | to be | 99.51 | per cent. |
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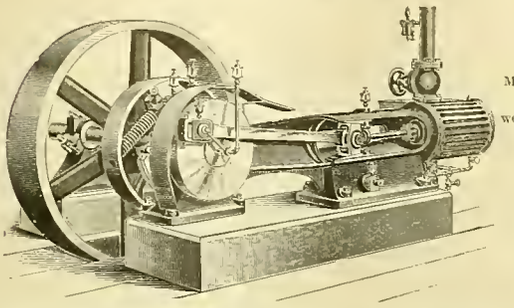

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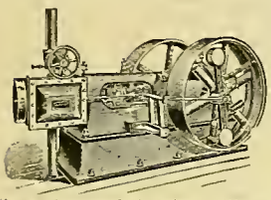

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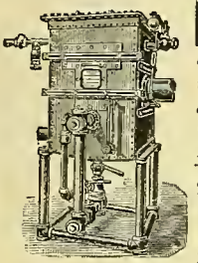

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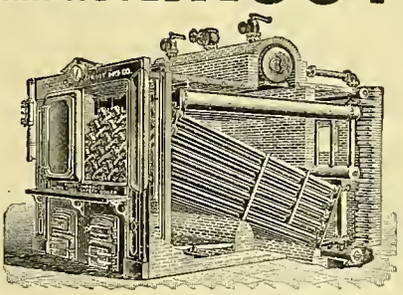

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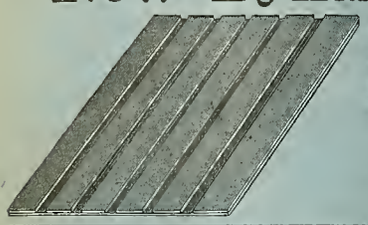

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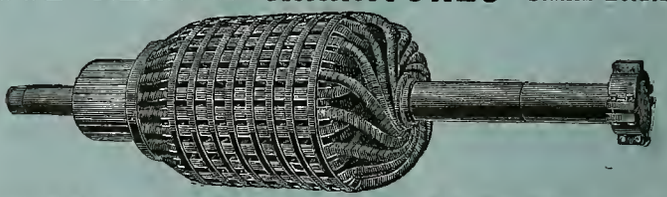

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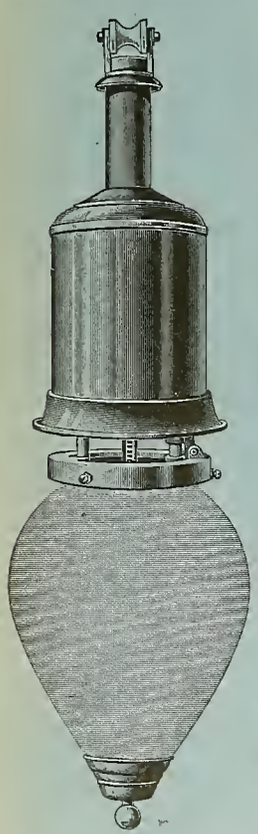

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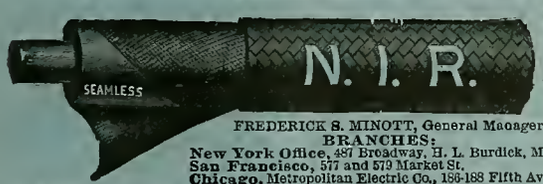


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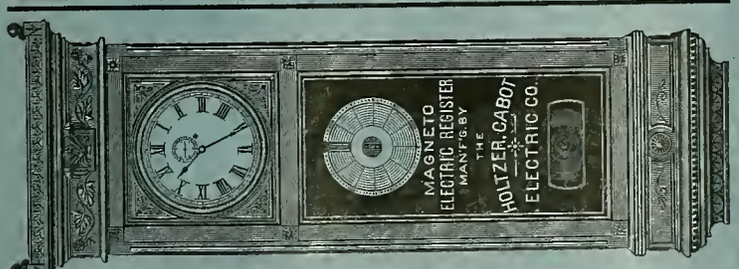


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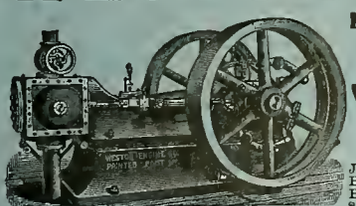

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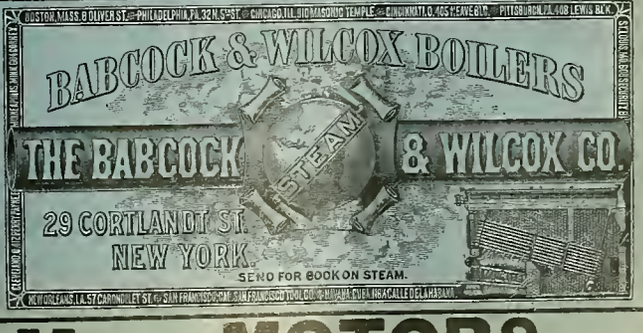


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*Belted or Direct Connected, And of Any Capacity.*

## EDDY MOTORS

*From 1-2 H. P. Upwards.*
*All Apparatus Guaranteed as Represented.*
THE EDDY ELECTRIC MFG. CO., WINDSOR, CONN.

Thomson '93 Standard Alternating Circuit Arc Lamp.

# THE THOMSON '93 ARC LAMP

FOR

## DIRECT, ALTERNATING, POWER AND RAILWAY CIRCUITS.

Thomson '93 Ornamental Arc Lamp.

WRITE FOR OUR CATALOGUE.

COMBINES THE FOLLOWING ADVANTAGES NOT FOUND IN ANY OTHER LAMP:

**EASE OF CARBONING.**
Motion of carbon rod entirely free. No loss of time in changing. No waste of carbon life.

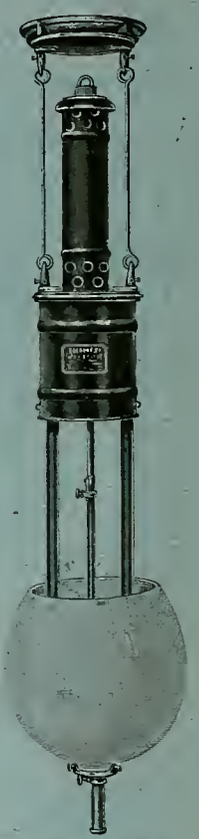
**FEWNESS OF PARTS.**
Parts interchangeable with all lamps, except the alternating current lamp.

**STEADY BURNING—NO HISSING.**

**PERFECT REGULATION.**
Regulation and feeding point independent of weight of carbon.

**SIMPLICITY AND SENSITIVENESS OF FEED MECHANISM.**
Neither clutch nor gear, but combines advantages of both. No troublesome escapement.

**EASE OF INSTALLATION AND ADJUSTMENT.**
Labor reduced to a minimum.



Thomson '93 Standard Lamp for Incandescent or Railway Circuits.

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For all business outside the United States and Canada—Thomson-Houston International Electric Co., Schenectady, N. Y. and 44 Broad St., New York. For Canada—Canadian General Electric Co., Ltd., Toronto, Canada.

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## CLASSIFIED LIST.


**Accumulators.**
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric Storage Battery Co
Porter & Buerdorf.

**Adjusters, Lamp.**
Dow Adjuster Co.

**Annunciators.**
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Central Electric Co.
Electric Appliance Co.
Electric Storage Battery Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Buebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Washington Electric Co.
Western Electric Co.

**Belting.**
Shultz Belting Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co., The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Fulton Steam Boiler Wks.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electrician Publishing Co.

**Brushes.**
Partridge Carbon Co.
Wirt, Chas.

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Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric.** (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Chicago Ins. Wire Co.
Cushing & Morse.
Eastern Electric Cable Co.
Hill, W. S. Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons, Points & Plates.**
Central Electric Co.
General Electric Co.
Jennings, A. R.
Metropolitan Electric Co.
Partridge Carbon Co.
Western Electric Co.

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Consolidated Car-Heating Co.

**Castings.**
Dutcher Co., J. A. & P. E.

**Clocks, Electric.**
Self-Winding Clock Co.

**Conduits**
Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

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Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Muncie Elec. Mfg. Co.
Washington Electric Co.
Wirt, Chas.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co
Muncie Elec. Mfg. Co.
Roberts & Co., E. P.
Rushmore, S. W
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Chicago Ins. Wire Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co. The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Chicago Cross Arm Co.
Electric Appliance Co.
Hubley Mfg. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Sioux City Brass Works.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Electric Railways.**
Brush Electric Co
General Electric Co.
Hubley Mfg. Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. B.
Cameron & Gillett.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Roberts & Co., E. P.
Rushmore, S. W.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng. & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Central Electric Co.
Interior Conduit & Ins. Co.
Muocie Elec. Mfg Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Palmer Bros.
Porter & Buerdorf.
Sioux City Brass Works.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Hubley Mfg. Co.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.
Hubley Mfg. Co.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
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Simplex Electrical Co.
Standard Paint Co.
Vulcanized Fibre Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Ins. Wire Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Hubley Mfg. Co.
Independent Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Jennings, A. R.
Mather Electric Co.
Metropolitan Electric Co.
New York & Ohio Co.
United Elec. Imp. Co.
Westinghouse Elec. & Mfg. Co.

**Lightning Arresters.**
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Wirt, Chas.

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**Mechanical Machinery.**
Bliss Co., E. W.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

**Motors.**
Bolgiano Mfg. Co.
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C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co.

**Packing.**
Garlock Packing Co.

**Paints.**
Standard Paint Co.

**Phosphor Bronze.**
Phosphor Bronze Sm. Co. Ltd

**Platinum.**
Baker & Co.

**Poles.**
Brownlee & Co.
Morris, Tasker & Co.
Nuttall Co., R. D.

**Porcelain.**
Empire China Works.
Chicago Gen'l Fixture Co.
General Electric Co.
Phœnix Glass Co.

**Publishers, Electrical.**
Electrician Publishing Co.

**Push Buttons.**
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.

**Rheostats.**
General Electric Co.
Rushmore, S. W.

**Sal Ammoniac**
Hayden-Booker Mfg. Co.
Innis & Co.
Klipstein, A. & Co.
Law Battery Co.

**Second-Hand Electrical Machinery.**
Gregory, Chas. E. Co.
Rushmore, S. W.

**Separators.**
Goubert Mfg. Co.

**Silk Braid.**
Boston Braid Mfg. Co.

**Slate.**
Independent Electric Co.
Jennings, A. R.

**Speaking Tubes.**
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.

**Speed Indicators**
Whitney Elec. Instrument Co

**Steam Heating.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Steam Pumps.**
Worthington, Henry R.

**Storage batteries.**
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric Storage Battery Co.
Porter & Buerdorf.

**Stoves, Electric.**
Consolidated Car-Heating Co.

**Street Cars.**
Brill, J. G. Co.

**Tapes, Insulating.**
American Electrical Works.
Central Electric Co.
Cushing & Morse.
Chicago Ins. Wire Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Metropolitan Electric Co.
Western Electric Co.

**Telephones.**
D'Unger Long Dist. Tel. Co
Harrison Int. Telephone Co.
National Telep. Mfg. Co.
Palmer Bros.
Western Electric Co.
Western Tel. Const. Co.

**Telephone Hooks.**
Bradley & Co.

**Transformers.**
General Electric Co.
Hornberger Elec. Mfg. Co
Ft. Wayne Elec. Corporation.
Jennings, A. R.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Trucks, Electric Car.**
General Electric Co.
Westinghouse El. & Mfg. Co.

**Turbine Wheels.**
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

**Type-Writing Machines.**
Yost Writing Machine Co.

**Universities.**
Cor. School of Industrial Sciences.
Correspondence School of Technology.
Scientific Machinist Co.

**Varnishes.**
Standard Paint Co.

**Water Wheels.**
Leffel & Co., Jas.
Smith, S. Morgan.

**Windlasses.**
Whitehead, S. E.

**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Electric Appliance Co.
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.

# DO NOT MAKE A MISTAKE

And think that the wire lowest in price is as good and will give as good service as that of a recognized high quality. In these days of sharp competition, price is a good indication of quality, but you cannot buy gold dollars below par. Neither can you buy the best wire on the market as low as the poorest, but you can buy it at very little difference—such a slight one that it does not begin to indicate the difference in quality.

***Simplex T. Z. R. Weatherproof Wire is the Standard of High Insulation.***

## SIMPLEX ELECTRICAL CO.,

Western Office, 1137-1138 Monadnock, CHICAGO.

# Cross Arms,

MADE OF **YELLOW (GEORGIA) PINE.**

**DO NOT ROT AT THE CAINS OR BOLT HOLES.**

**THEY ARE STRONGER, THEY LAST LONGER.**

**We Sell in Any Quantities.**

**STOCK OF ASSORTED SIZES CARRIED IN CHICAGO.**

ALSO PINS AND BRACKETS.

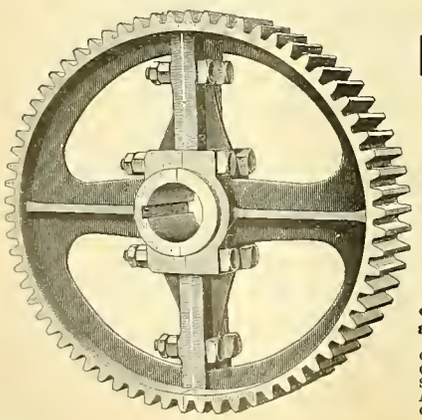
***LET US HEAR FROM YOU.***

## Chicago Cross Arm Co.,

**932 Monadnock Block. - CHICAGO.**

## R. D. NUTTALL COMPANY, Allegheny, Pa.

F. A. ESTEP, President and Treasurer.
J. R. McGINLEY, Vice-President.
F. S. MARTIN, Superintendent of Works.



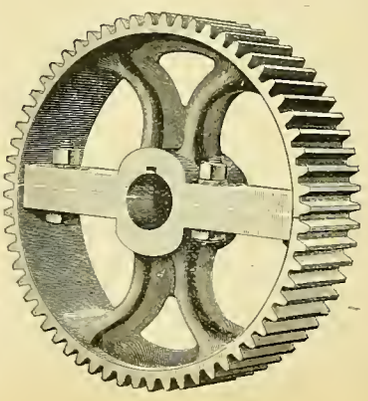
MANUFACTURERS OF

**Electric Railway Supplies.**

**GEARS, PINIONS, BEARINGS, TROLLEYS, TROLLEY WHEELS AND HARPS.**

THIS IS THE IMPROVED NUTTALL TROLLEY.

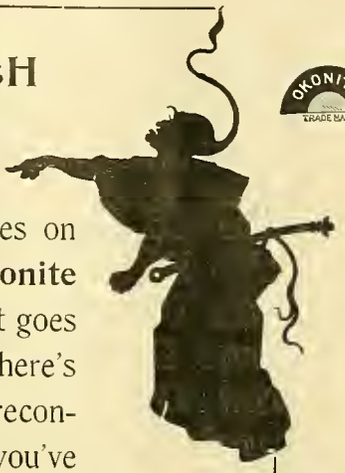
TRY IT ONCE, AND YOU WILL WANT NO OTHER.



**The largest and most prosperous street railway companies in the country are using our supplies, and they prefer them to all others on account of greater strength and durability. Correspondence solicited.**

CHAS. J. MAYER, 600 Betz Building, Philadelphia, Pa., Middle States Sales Department.
CHAS. N. WOOD, 180 Summer St., Boston, Mass., New England States Sales Department.
STANDARD R'Y SUPPLY CO., Monadnock Block, Chicago, Ill., N. W. States Sales Department.
A. S. PARTRIDGE, Bank of Commerce Building, St. Louis, Mo., S. W. States Sales Department.
CHAS. A. CAVAONA, Neave Building, Cincinnati, Ohio, Central States Sales Department.

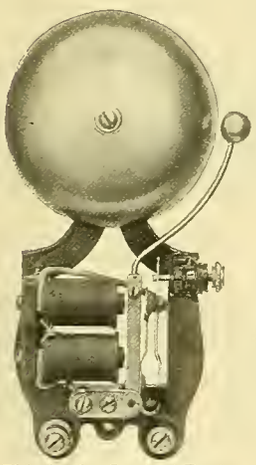
## iT woulD astonisH




most anybody to have the cold, black figures pointed out showing the great quantity—the miles on miles—the tons on tons of **Okonite** that are reeled off every year. It goes everywhere—and stays there—there's no necessity for tearing out, reconstructing, and so forth, *after* you've put in Okonite. Many times it must be done before. We don't believe that you want to risk your reputation as an engineer, nor the success of the installation, by chancing something inferior.

*We know we are right.*

## Here is a Bell



This is the Contact Protected Dust-Proof Bell.

That will meet the instant approval of every Contractor or Bell-fitter who has had to contend with the numerous difficulties in the way of assuring his customers uninterrupted service.

Nothing is more annoying than to be called a long distance just to chase a bug out of the contact-points, or to blow away a speck of dust. Various insect-proof frames and boxes have been designed, but in each the really *vital* point was left unprotected. **In this bell** *the contact points are sealed.* No bug, no dust or other obstruction can prevent ringing. We have this bell in various sizes. Also a full line of House Goods Specialties, Annunciators, Batteries, Insulated Wires, Push Buttons and Construction Tools.

*Orders and correspondence given prompt attention.*

BRANCHES:
St. Louis: Southern Electrical Supply Co.
Kansas City: Gate City Electric Co.

**Central Electric Company,**
173-175 Adams Street, CHICAGO.

GENERAL WESTERN AGENTS

Okonite Wires, Interior Conduit, Lundell Fans, Helios Arc Lamps,
Washington Carbons, Carpenter Enamel Rheostats.

# ELECTRICAL HOUSE GOODS.

We have the best and most complete line on the market. Our goods are well known, and are unapproached in design and mechanically. They are made for use and wear, and not simply to sell at a low price.

The following well known and standard goods we keep always in stock:

**Diamond Carbon Batteries, Ajax Dry Batteries, Excelsior Disque Le Clanche Batteries, Ansonia Gravity Needle Annunciators, O. & U. Wood Box Bells, Eureka Iron and Wood Box Bells, Ansonia Patent Iron Frame Bells, also Pushes, Buzzers, Annunciator and Office Wire, Single and Duplex Learners' Sets, Spark and Induction Coils, Gas Keys, Burglar Alarms, Door and Window Springs, Pure Sal-Ammoniac, Blue Vitriol and Chromo Acid.**

Our stock is all new and fresh.
No shopworn goods or out of date styles.
We want business, and are making very low prices to secure it.
Write for what you want.
Send for price list.

## WALLACE ELECTRIC CO., 307 Dearborn St., Chicago.

# We Want Western Business.

# LA ROCHE ALTERNATORS.

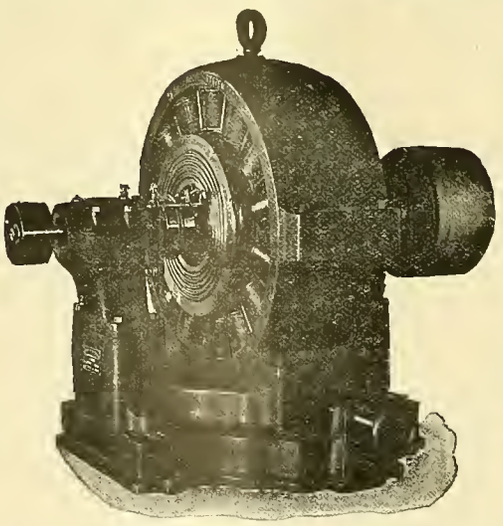
MANUFACTURED IN SIZES FROM

*25 to 5,000 Lights,*

SINGLE OR MULTIPHASE.

Direct Connected Dynamos.

Direct Current Generators.



1,000 Light Alternator.

## La Roche Electric WORKS,

PHILADELPHIA, PA.

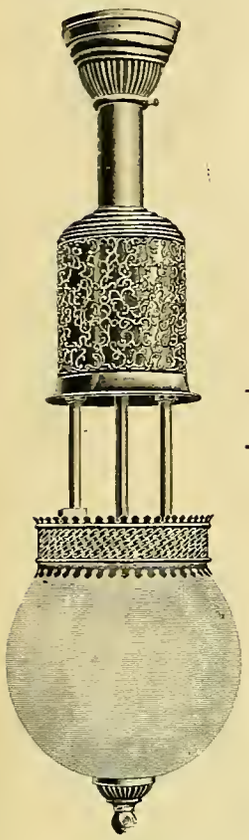
DISTRICT OFFICES:

New York, Boston, Knoxville, Cincinnati, Pittsburg, San Francisco, Chicago, St. Louis, Mobile.

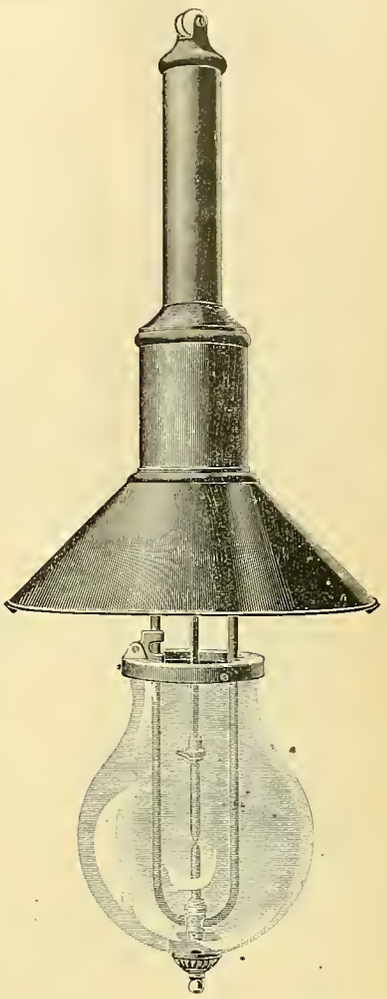
## HOOD & OSBURN, 239 La Salle Street, CHICAGO.

## OWEN FORD, Rialto Building, ST. LOUIS, MO.

# THE BEST LAMP ON EARTH.



For Direct Current.
For Street Railway Circuits.
For Alternating Circuits.
For Series Arc Circuits.



## NEW AND SUPERIOR.

These lamps are far better than anything manufactured in the line of arc lamps—stronger, simpler, more durable and easier to maintain. They are ALL weatherproof. A trial will convince you of their merits.

**These lamps, both "Twin" and Single, after an exhaustive competitive test, were adopted for use in Brooklyn for low tension street lighting and are now in successful operation.**

We manufacture all kinds of focusing lamps, search lamps, theatrical lamps, stereopticon lamps, and special lamps of any description. In short, if you want ***anything*** in the line of arc lamps, write us before purchasing elsewhere.

We are prepared to furnish promptly ornamental lamps of handsome design, for either direct or alternating current, finished to suit the customer.

# ELECTRIC CONSTRUCTION & SUPPLY CO.,

*Established 1881.*

18 CORTLANDT ST., NEW YORK.

**Wallace Electric Co., Agents, 307 Dearborn St., Chicago, Ill.**

# THE C & C ELECTRIC COMPANY

MANUFACTURERS OF

## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

General Office:
143 Liberty Street, NEW YORK.

Works: CARWOOD, N. J.
on CENTRAL R. R. of N. J.

BRANCH OFFICES: CHICAGO, 1020 and 1021 Monadnock Building. BOSTON, 63 Oliver St.
CLEVELAND, Cuyahoga Building. PHILADELPHIA, 633 Arch St.

THE

# MON-ARC

THE
BEST and SIMPLEST
ALTERNATING
ARC LAMP
NOW ON
THE MARKET.

....Also Arc Lamps for....

Constant Current Circuits,
Constant Potential Circuits.

Write for prices.

## THE F. P. LITTLE
## Electrical Construction & Supply Company,

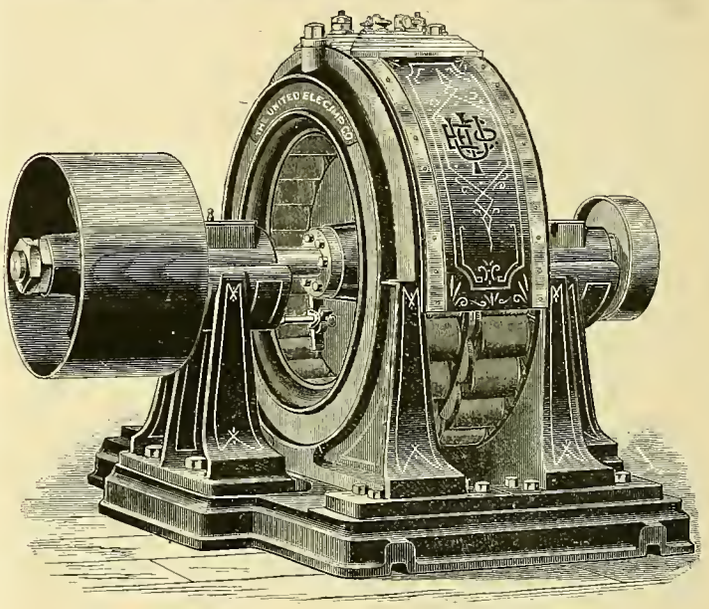
*BUFFALO, N. Y.*

Western Agt. with Metropolitan Electric Co., Chicago, Ill.
New England Agt., G. M. Angier & Co., Boston, Mass.
Russell & Officer, Denver, Colo., Agents for Colorado, Utah, Wyoming, New Mexico and Arizona.

# Alternating Current Generators,

**For Central Station Equipment.**

Adapted for Arc and Incandescent Lighting.
Guaranteed Equal in Every Respect to any other Type of Apparatus Manufactured.




Slow Speed and Close Regulation.

Standard of Simplicity and Durability.

**ALSO**

Direct Current Apparatus for Lighting Factories, Public Buildings and Isolated Plants.
Improved Long Distance Series Incandescent Apparatus for Street and Commercial Illumination.
Incandescent Lamps and Sockets for use on Arc Light Circuits.

**Correspondence Solicited.**

## THE UNITED ELECTRIC IMPROVEMENT CO.,

Drexel Building, Philadelphia, Pa.

# STREET LIGHTING FROM ALTERNATING CURRENT DYNAMOS.

New Prices given on Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters

And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.

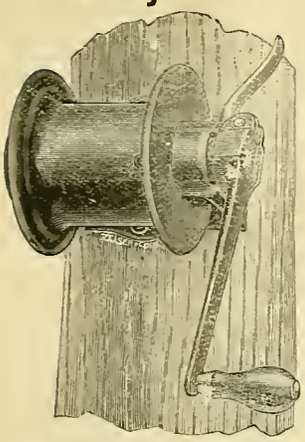
*This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.*

# OUR SERIES LAMPS

*Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.*

# BERNSTEIN ELECTRIC COMPANY, 620 Atlantic Ave., Boston, Mass.

# The Eddy Patent Self-Locking Windlass



WINDLASS UNLOCKED.

For Raising and Lowering Arc Lamps.

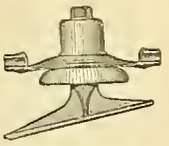
*Insure the safety of your lamps by using the ONLY positive and absolutely safe self-locking windlass made.*

The crank is the only key that will unlock it. Principle of construction is a mechanical perfection. No complicated parts. Locking device absolutely reliable. Cannot be tampered with. It is sleet-proof; is quick and easy to operate.

The Simplest, Safest and Best Windlass in the World.

**S. E. WHITEHEAD,**
General Agent for the U. S.,
CARTHAGE, MO.

# MOULDED MICA



# TROLLEY LINE INSULATORS.

*Hangers, Pull-Overs, Bracket Arm Insulators, Guard Wire, Feed Wire, Giant Strain and Section Insulators, Frogs, Crossings, Rail Bonds, Etc, Etc.*

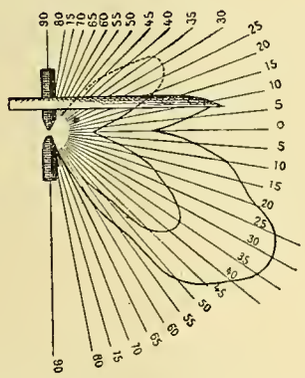
**VULCABESTON** heat-proof insulation for Magnet Spools, Bushings, Controller parts, Etc.
**ASBESTOS** for Fire-Proofing and Electrical Purposes.

**H. W. JOHNS MFG. COMPANY,**
*240 and 242 Randolph Street, - CHICAGO, ILL.*
NEW YORK. PHILADELPHIA. BOSTON.

# A GREAT REDUCTION

# In Prices

ON OUR




# REFLECTOR PLATE ALTERNATING ARC LAMPS.

**We claim better distribution of light than any other alternating lamp in the market. We accomplish this by means of**

***OUR REFLECTOR PLATE.***

**We claim that we can obtain more economy than any other alternating lamp in the market.**

**We do this by means of the**

***SPENCER ECONOMY COIL.***

**We will beat the market for prices on Helios carbons this fall.**

# Helios Electric Co.,

## 1310 FILBERT ST., PHILADELPHIA, PA.

Now that summer is about over and the

# FALL CAMPAIGN

For business is about to begin, allow us to remind you that we are in the best possible position to assist you to make your increased business

# PROFITABLE.

We presume this is the keynote of your business endeavor, and only wish to say that some of the **MEANS TO THIS END** are

**"O. K." WEATHERPROOF LINE WIRE**
To successfully maintain the insulation of your lines.

**PARANITE WIRE**
To enable you to do perfect inside work.

**PACKARD TRANSFORMERS**
To efficiently handle your customers' supply.

**PACKARD LAMPS**
To give your customers the most satisfactory light.

We are headquarters for these and everything else you will need in the electrical supply line.

**ELECTRIC APPLIANCE COMPANY,**
**242 Madison Street, CHICAGO.**

---

**OCTAGONAL PINE POLES,**
**NORWAY PINE CROSS-ARMS,**
**WHITE OAK PINS.**
**It will pay you to get our prices**
**BROWNLEE & CO., - Detroit, Mich.**

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**PURE**
**SAL-AMMONIAC.**
Guaranteed Over 99 Per Cent. Fare.
**INNIS & CO.,**
**161 Kinzie St. Chicago.**

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*Never Argy Agin a Success.*
—ARTEMUS WARD.

Our **UNIVERSAL TELEPHONE SWITCH HOOK** is the only perfect device of its kind on the market. Send for Price List and Circular which will explain all about it. We will mail sample for only 75 cents.

**BBADLEY & CO.,**
*References:* 7, 9 and 11 Stone St., Alliance Bank, **ROCHESTER, N.Y.**
Rochester,
or any business firm in our city.

---

# KARTAVERT.

HARD FLEXIBLE FIBRE IN SHEETS, RODS, AND TUBING.
For Electrical and Mechanical Purposes, Railway Dust Guards, Washers, and Packings. Pat. Insulating Cleats.
MANUFACTURED BY
**THE KARTAVERT MFG. CO., Wilmington, Del.**

---

# WIRT INDICATORS.

I have purchased the Wirt Laboratory from the assignee of the Ansonia Electric Co., together with a large stock of Wirt Indicators; these instruments are all new and in first-class condition. They include indicators for direct and alternating current ranging from 10 to 1,000 amperes and from 2½ to 3,000 volts. While this stock lasts I will make extremely low prices. Apply to the undersigned or to your regular dealer

***CHARLES WIRT, 56 5th Avenue, Chicago, Ill.***

---

**BINDERS**
**For the WESTERN ELECTRICIAN,**
**—$1.00.—**

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**PLATINUM**
**For all Purposes.**
Scrap and Native Platinum Purchased.
**BAKER & CO., 408-414 New Jersey Railroad Ave., Newark, N. J.**

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The Only Clocks Used in the W. U. Tel. Co. Time Service.

**NO WINDING. CORRECTED HOURLY.**

**SELF-WINDING CLOCK CO.,**
26 Broadway, NEW YORK.
*Clocks Sold. Clocks Rented.*

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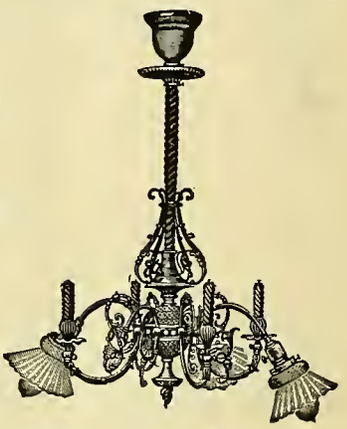
# W. S. EDWARDS MFG. CO.,

MANUFACTURERS OF

**ELECTROLIERS,**
**Combination Fixtures,**
**Electric and Combination Brackets.**

EXCLUSIVE DESIGNS.
LOW PRICES.

SEND FOR CATALOGUE.



**21 and 23 E. Lake St. Chicago.**

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*Siemens & Halske Electric Company of America,*

*Siemens & Halske. Berlin, Charlottenburg, Vienna, St. Petersburg.*

—— MANUFACTURERS OF ——

# DIRECT CURRENT MULTIPOLAR DYNAMOS AND GENERATORS.

These machines are constructed with outside revolving armatures, without and with special commutator, as desired. They have proved remarkably efficient and economical. Used largely in European Central Stations. They are slow-speed machines, made for direct connection to engine without belting, and in sizes from 20 H. P. to 1,500 H. P.

**HIGH-SPEED BELTED SIEMENS DYNAMOS**
Are copied extensively in this country as "Drum Type." We are building these machines in sizes from 1 H. P. to 150 H. P.

**ALTERNATING AND MULTIPHASE CURRENT DYNAMOS**
With laminated field and armature, in sizes from 1 H. P. to 4,000 H. P., for belted or direct coupling.

**MOTORS**
Of every speed for direct, alternating or multiphase current, in sizes from 1-10 H. P. up to 4,000 H. P. Durable and economical in operation.

**SIEMENS BAND LAMPS**
For direct and alternating current, for constant potential and series machines.

**SIEMENS ARC LIGHT CARBONS**
With either solid or soft cores, which are the most economical in the world and give a steady light.

**ALL INSTRUMENTS**
Requisite for the regulation of electric apparatus; also the Siemens Voltmeters and Ammeters and Automatic devices made in Berlin.

**GENERAL OFFICES, MONADNOCK BUILDING, CHICAGO.**

New York Office, 135 Liberty Street, Cincinnati Office, Perin Building, Denver Office, 618 Boston Block, St. Louis Office, Bank of Commerce Building
Salt Lake City Office, Dooly Block. Boston Office, 31 Milk Street. Pittsburg Office, 830 Liberty Ave. Buffalo, N. Y. Office, Erie Co. Bank Building.
New Orleans Office, 42 Union Street. Troy, N. Y. Office, 43 Fourth St. Philadelphia Office, 531 Chestnut St. San Francisco Office, 508 California Street.
Toledo, Ohio, Office, 518 Summitt Street. Detroit, Mich., Office, 47 State Street. Minneapolis Office, 939 Lumber Exchange.

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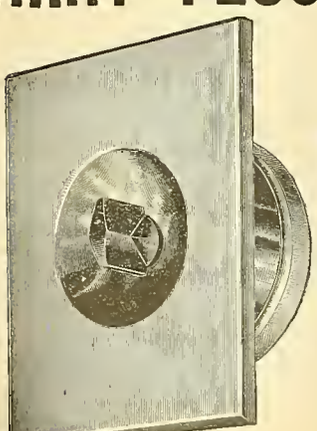
# HART FLUSH SWITCHES.



5 and 10 Ampere Single Pole.
10 Ampere Double Pole.
10 Ampere Three-way.

**The Only Snap Switch that has**
**PROVEN A SUCCESS.**

**For Sale by All Supply Houses.**

**The Hart & Hegeman**
**MANUFACTURING CO.,**
**HARTFORD, CONN.**

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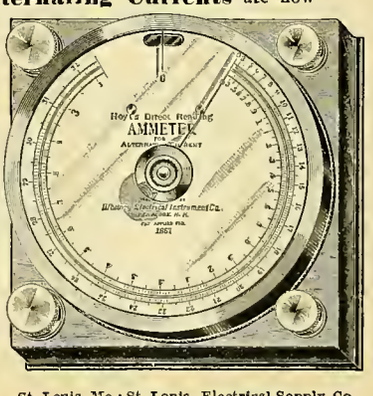
# Something New.

The **Hoyt Standard Ammeters** and **Voltmeters** for **Lamp** and **Meter** measurement on **Alternating Currents** are now ready for the market.

Send for our **1894 Catalogue** which contains the above and other new instruments of our manufacture.




**Whitney Electrical Instrument Co.,**
**PENACOOK, N. H.**
Factories: Penacook, N. H.; Sherbrooke, P. Q., Can.

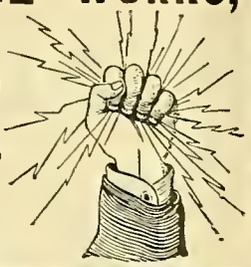
AGENTS:

HENRY F. KELLOGG, General Selling Agent.
Baltimore, Md.: The Poole Electric Co.
Boston, Mass.: Warren S. Hill.
Boston, Mass. (New England): W. B. Southgate & Co., 146 Franklin St.
Chicago, Ill: Electric Appliance Co.
Cincinnati, O.: Nowotny Electric Co.
Halifax, N. S.: John Starr, Son & Co., Ltd.
New York City: Geo. L. Colgate, 136 Liberty St.
San Francisco, Cal.: California Electrical Works.
Toronto, Ont: Toronto Electrical Works.
St. Louis, Mo.: St. Louis, Electrical Supply Co.
Little Rock, Ark.: The Brown Elec. & Mach'ry Co.

Eugene F. Phillips, Prest. W. A. Hathaway, Treas. W. H. Sawyer, Sec'y.

# AMERICAN ELECTRICAL WORKS,

**PROVIDENCE, R. I.**



RAILWAY FEEDER AND TROLLEY WIRE,

ELECTRIC LIGHT LINE WIRE,

Incandescent and Flexible Cords,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.

NEW YORK OFFICE, P. C. Ackerman, 10 Cortlandt Street.

MONTREAL BRANCH, Eugene F. Phillips' Electrical Works

## Miamisburg Electric Co.,

Miamisburg, O.

### IMPERIAL DRY BATTERY.

Guaranteed the best Dry Battery ever made. Interoeal short circuiting or local action is elimicated. Will not deteriorate when not doing work. Will hold its first value over long periods of time Iooeroal resistance small; high and constant, E. M. F. Will not run down or die on the shelf. No bureting of eeals or oozing of salts from the top.

### Burnley Cartridge Battery.

Cartridge or Porous Cups made of especially prepared paper. One-half the size and one-third the weight of other porous cups. Guaranteed to be equal to any Salammoniac battery made. The cheapest battery now on the market.

A'l Batteries Guaranteed. Send for Catalogue.

THE

# "CLARK" WIRE.

TRADE MARK.

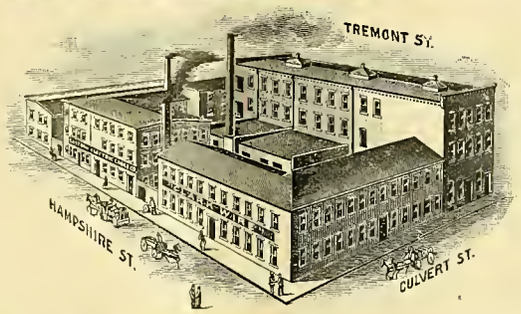
For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

Western Agents,

GREAT WESTERN MFG. CO.,

Chicago, Ill.




**In a Letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A Thoroughly Reliable and Desirable Wire in every respect."**

The Rubber used in insulating our Wires and Cables is especially chemically prepared, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat.

We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first class Insulated Wire.

We shall be pleased to mail Catalognes with Terms and Discounts for Quantities.

## EASTERN ELECTRIC CABLE CO.,

61 and 63 Hampshire St., Boston, Mass.

Henry A. Clark, Treas. and Gen'l Mgr. Herbert H. Eustis, Prest. and Electrician

**Send for Catalogue.**

Dynamos and Motors and PARTS OF SAME

ALL KINDS PRICES OF PARTS TELEPHONES ELECTRICAL SUPPLIES

SEND STAMP FOR CATALOGUE PALMER BROS. MANUS, CONN.

THE

## Consolidated Electric Storage Company,

**BRUSH PATENTS,**

Licenses Granted.

EDISON BUILDING, NEW YORK.
DREXEL BUILDING, PHILADELPHIA.

## Correspondence School of Technology,

**CLEVELAND, OHIO,** Instruction by Correspondence, Electrical, Steam and other Branchee of Engineering.—E P. Roberts, M. E.; G. T. Hanchett, S. B.; Oscar Antz, M. E.; Jas. Ritchie, B. S.; Frank C Osborn, C. E.; F. Yeasen; L. S. Siebel; H. J. Cook; J. N. Richardson; W. B. Sewart and F. H. Constant, C. E. Send for Circular.

## Subscribe for the Western Electrician.

HAYDEN-BOOKER MFG. COMPANY,

Manufacturers of all kinds of

OPEN AND CLOSED CIRCUIT CELLS,

And Dealers in

Everything in the Battery Line.

2140 DeKalb St., - - - St. Louis, Mo.

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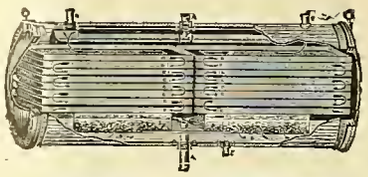

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One 50-light Standard arc 2,000 C. P. dynamo; one 50-light American arc 2,000 C. P. dynamo; one 45-light T.-H. arc 1,200 C. P. dynamo; about twenty (20) smaller arc machines; all machines have a full complement of lamps; one 2,500-light National alternator; one 750-light Westinghouse alternator; one 750-light Slattery alternator; one 500-light T.-H. alternator; all station instruments are with machines. Hard time prices.

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Gas and electric light plant in one of the best cities in Texas Incorporated; capital paid up, $60,000. Net profit this year over expenses, $5,000 Much room for development. Desire to secure competent man with some means to take an interest and manage it, or will sell. Address Lock Box 6, Corsicana, Texas.

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Will be sold at public sale on Monday, September 3d, 1894, to the highest bidder.

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Five hundred light transformer capacity.
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DEPARTMENT OF THE INTERIOR,
WASHINGTON, D. C., August 25, 1894.

Sealed proposals (in duplicate) will be received at the Department of the Interior until 3 o'clock p. m. Monday, September 24, 1894, for the construction of a Telephone Exchange System for the Department of the Interior and at the same time and place proposals will also be received for the extension and modification of the present Telephone System of the Interior Department. Bids must be made on Government blanks. Blank forms of proposal, specifications, etc., may be obtained on application at the office of the Chief Clerk of the Department, where drawings showing details may also be inspected. All proposals received will be opened at the time and place above stated, and bidders are invited to be present at such opening.

JNO. M REYNOLDS, Acting Secretary.

## SEALED PROPOSALS

Will be received by the City of Jackson, Tenn., until 12 o'clock noon, October 2, 1894, for furnishing, operating and maintaining forty double arc 2,000 candle power electric lamps on the streets of said city, with the privilege of 50 at the same price per light, for a term of five years. An exclusive franchise will also be granted for all arc and incandescent lighting for both commercial and domestic use for a term of five years. For specifications, etc., apply to

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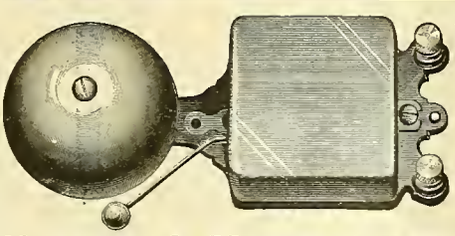

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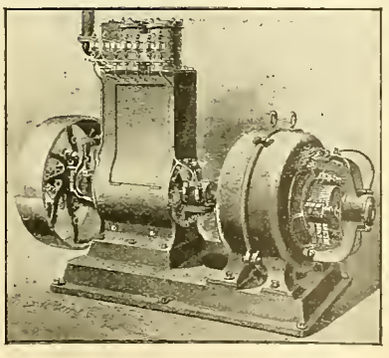

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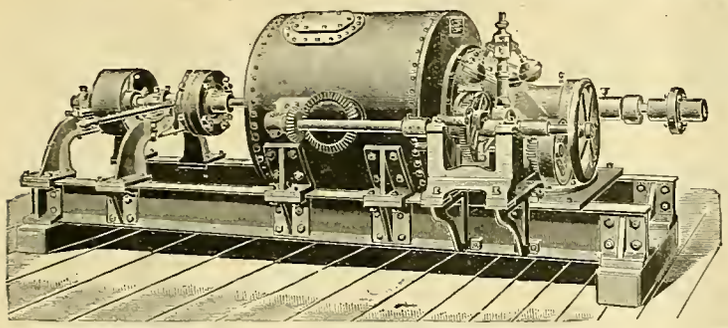

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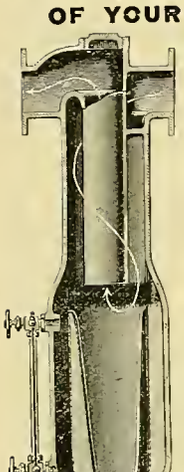

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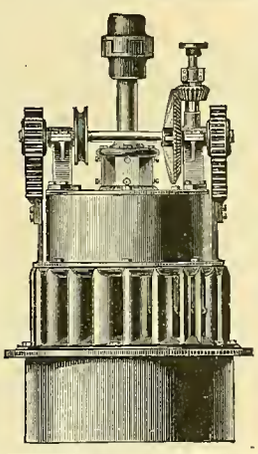

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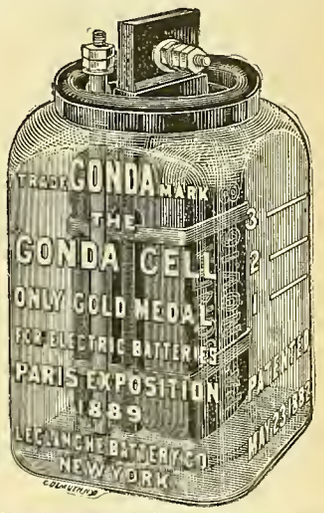


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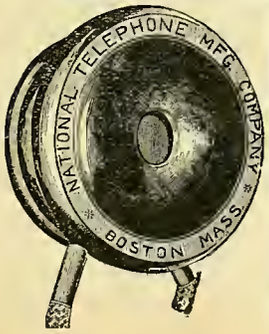


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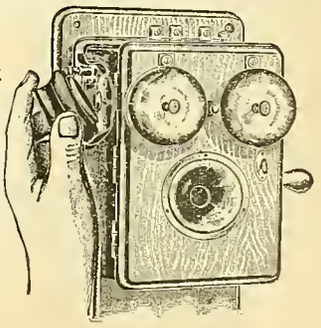

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Method of Placing Receiver in Holder.

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Very low prices quoted on sizes to order.

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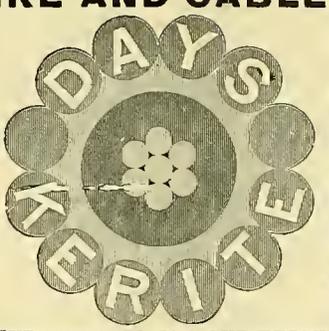


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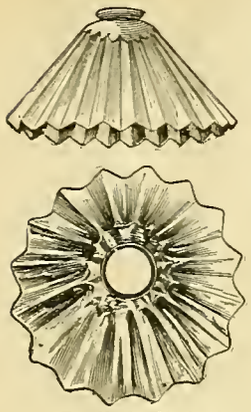

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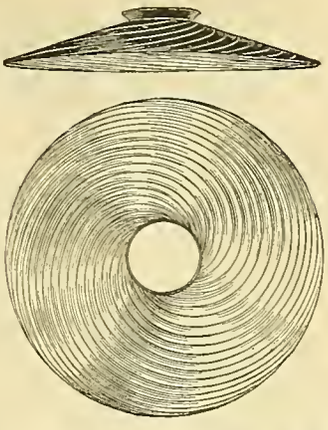

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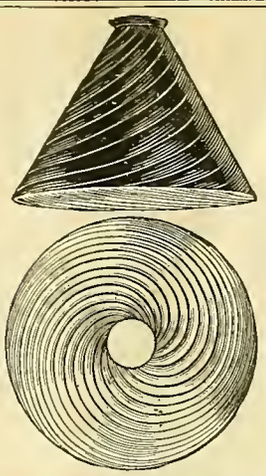

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Enameled Green Outside, Silvered Inside.

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Always bright; cannot tarnish.

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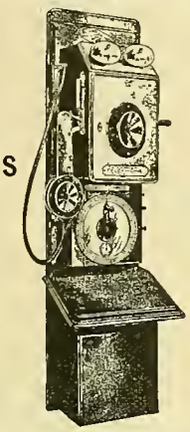

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Prospectuses furnished by addressing the Company at their offices,

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This company is manufacturing

## A Compound Magneto Telephone

which it sells outright under a guarantee both as to efficiency and as against infringement of patents.

It talks as well over one hundred miles as any other Telephone talks over one mile.

This company is also prepared to fully equip Telephone exchanges, (furnishing everything from the telephone to the wire and poles). Private lines, Factory plants, etc., and do all kinds of construction work.

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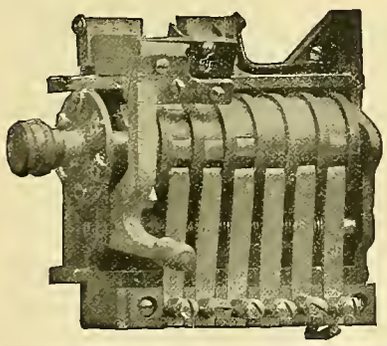

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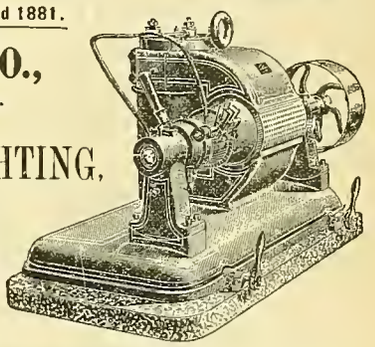

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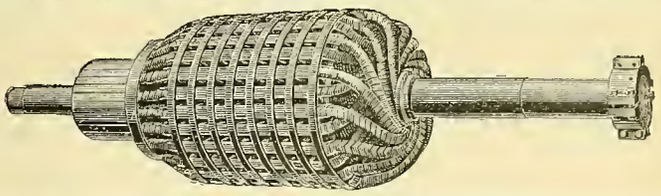

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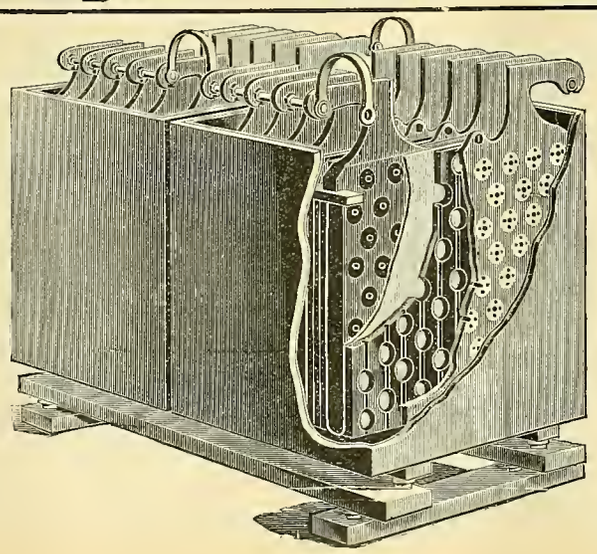

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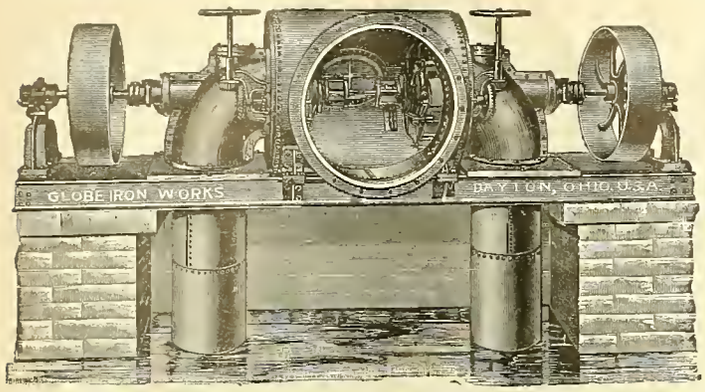


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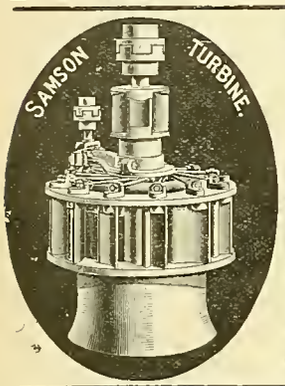


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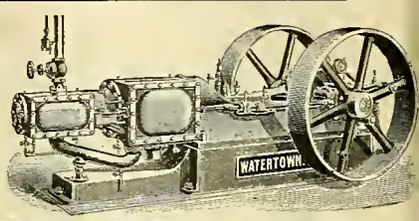


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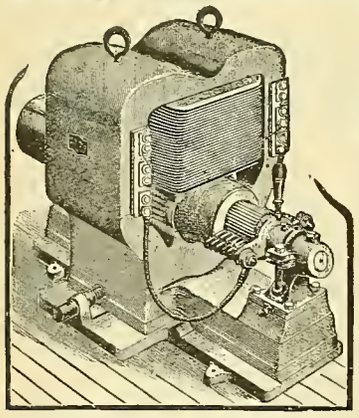

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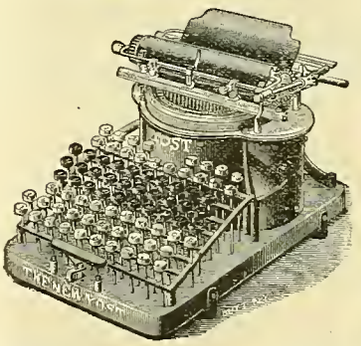


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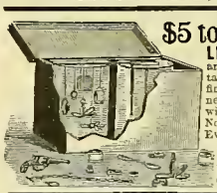

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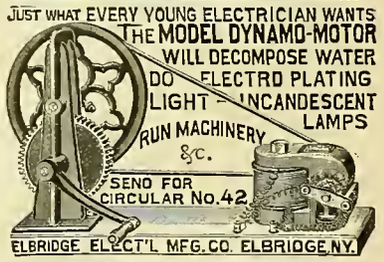


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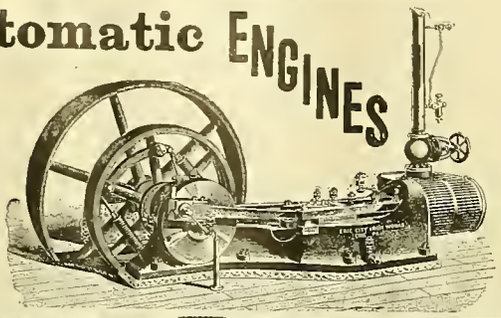

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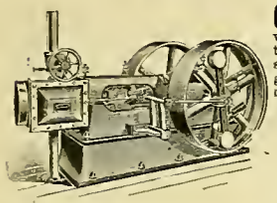

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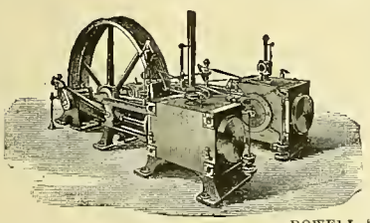

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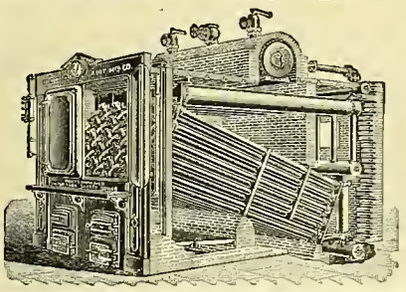

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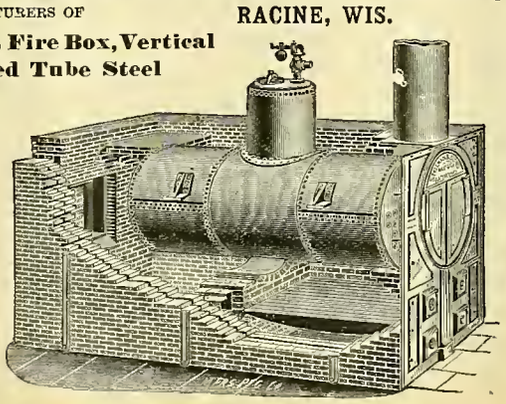

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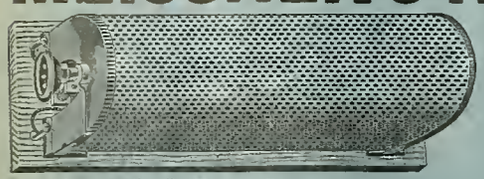

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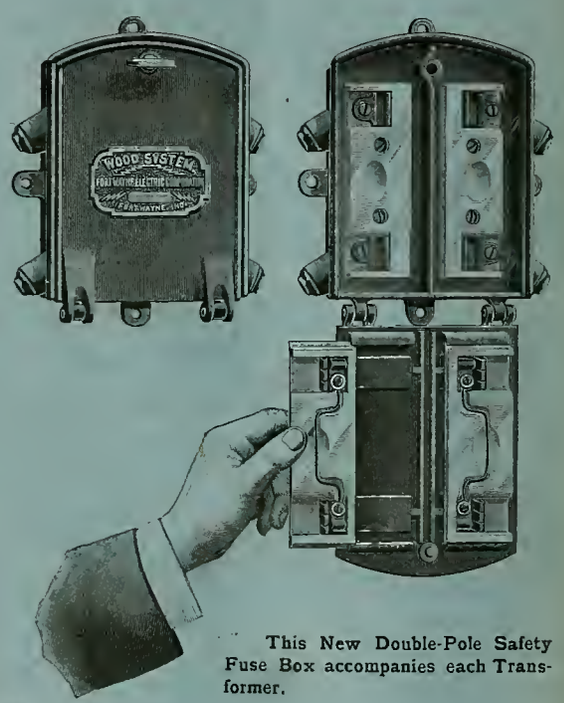


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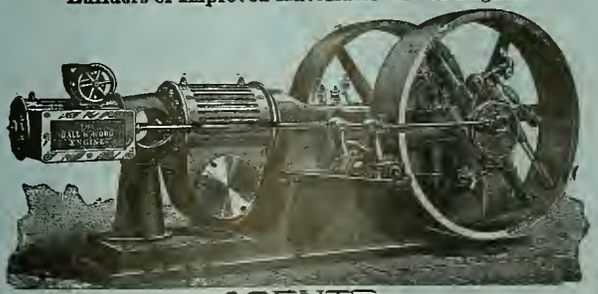

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Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Electric Railways.**
Brush Electric Co
General Electric Co.
Hubley Mfg. Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Cameron & Gillett.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Roberts & Co., E. P.
Rushmore, S. W.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electrollers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Engravers.**
Illinois Engraving Co.

**Fan Motors.**
Bolgiano Mfg. Co.
Central Electric Co.
Interior Conduit & Ins. Co.
Muncie Elec. Mfg Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.

**Gears**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Canot Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Palmer Bros.
Porter & Buerdorf.
Sioux City Brass Works.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Hubley Mfg. Co.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.
Hubley Mfg. Co.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Vulcanized Fibre Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Ins. Wire Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Hubley Mfg. Co.
Independent Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Jennings, A. R.
Mather Electric Co.
Metropolitan Electric Co.
New York & Ohio Co.
United Elec. Imp. Co.
Westinghouse Elec & Mfg. Co.

**Lightning Arresters.**
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Wirt, Chas.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery.**
Bliss Co., E. W.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

**Motors.**
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Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
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Sioux City Brass Works.
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Whitney Elec. Instrument Co

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**Steam Pumps.**
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Cons. Electric Storage Co.
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Electric Storage Battery Co.
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**Street Cars.**
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Cushing & Morse.
Chicago Ins. Wire Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
Central Electric Co.
Electric Appliance Co.
Greeley & Co., The E. S
Metropolitan Electric Co.
Western Electric Co.

**Telephones,**
D'Unger Loug Dist. Tel. Co
Harrison Int. Telephone Co.
National Telep. Mfg. Co.
Palmer Bros.
Western Electric Co.
Western Tel. Const. Co.

**Telephone Hooks.**
Bradley & Co.

**Transformers.**
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Jennings, A. R.
Royal Electric Co.
Stanley Electric Mfg. Co.
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Assured by the Use of

**SIMPLEX T. Z. R. WIRE** *FOR LINE WORK.*

**SIMPLEX BRAIDED CAOUTCHOUC** *FOR INSIDE WIRING.*

**SIMPLEX MINING WIRE** *FOR MINES AND EXTREMELY DAMP PLACES.*

**SIMPLEX LEAD COVERED AND ARMORED CABLES**
*FOR UNDERGROUND AND SUBMARINE WORK.*

**SIMPLEX INSULATING PAINT,** *NOT THE CHEAPEST, BUT THE BEST.*

**SIMPLEX ELECTRICAL CO.,** Western Office, 1137-1138 Monadnock, Chicago.

# HAVE YOU INVESTIGATED

The merits of the Stanley Two-Phase System of Alternating Current Apparatus?

It will pay you to do so, as its earning capacity is much greater than anything else on the market.

Light and Power can be supplied by this system from the same generator and circuit.

## THE GENERATOR

Is superior to all others in efficiency, simplicity, durability and inherent regulation.

## THE MOTORS

Are self starting, take current in proportion to their load, substantially as direct current motors do, and are more simple, durable and convenient to use than direct current motors.

## THE STANLEY TRANSFORMERS

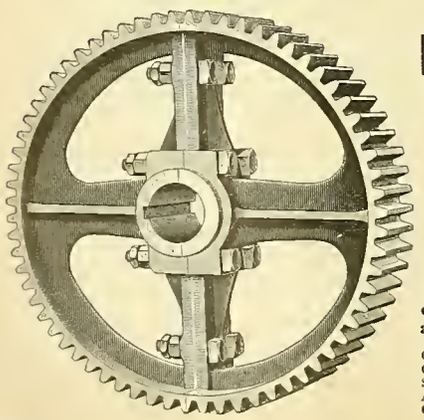
Excel all others in efficiency, regulation, convenience, safety and durability. We insure them for a term of years at a small premium.

# STANLEY ELECTRIC MFG. CO., PITTSFIELD, MASS.

**Western Office, 307 Dearborn St., Chicago, Ill.**

# R. D. NUTTALL COMPANY, Allegheny, Pa.

F. A. ESTEP, President and Treasurer.
J. R. McGINLEY, Vice-President.
F. S. MARTIN, Superintendent of Works.



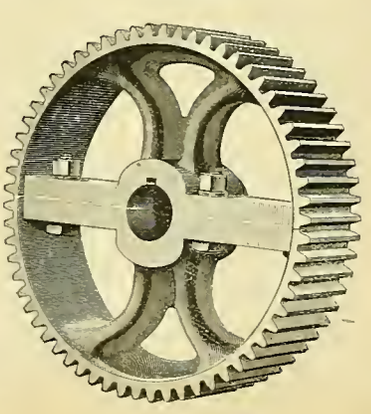
MANUFACTURERS OF

**Electric Railway Supplies.**

GEARS, PINIONS, BEARINGS, TROLLEYS, TROLLEY WHEELS AND HARPS.

THIS IS THE IMPROVED NUITALL TROLLEY.

TRY IT ONCE, AND YOU WILL WANT NO OTHER.



**The largest and most prosperous street railway companies in the country are using our supplies, and they prefer them to all others on account of greater strength and durability. Correspondence solicited.**

CHAS. J. MAYER, 600 Betz Building, Philadelphia, Pa., Middle States Sales Department.
CHAS. N. WOOD, 180 Summer St., Boston, Mass., New England States Sales Department.
STANDARD RY SUPPLY CO., Monadnock Block, Chicago, Ill., N. W. States Sales Department.
A. S. PARTRIDGE, Bank of Commerce Building, St. Louis, Mo., S. W. States Sales Department.
CHAS. A. CAVAGNA, Neave Building, Cincinnati, Ohio, Central States Sales Department.

**The Best Appointed and Largest Electrical Supply House in the World.**

WE HAVE purchased the entire stock of **Electrical House Goods** manufactured by the **DETROIT ELECTRICAL WORKS.**
(They having decided to discontinue the business).

The line of HOUSE GOODS made by this well known concern has, for years, been recognized by consumers and the trade as standard.

The goods which we have bought are all fresh, new and perfect (there is not a defective or shopworn piece in the whole lot), they are of the very latest design and embody the best that has been accomplished in recent improvements.

The entire stock is now in our Chicago store, arranged on our shelves, and listed at prices that should move it out as rapidly as we can ship.

We bought at very low figures, and will divide the honors with our customers.

## Annunciators.

Elevator style, 2 ind. and up. House style, single column, 2 to 6 ind. House style, double column, 4 to 15 ind. Burglar Alarm, 3 to 8 ind. Burglar Alarm, with clock, 12 indications.

Annunciators finished in Oak, Walnut, Cherry.

**Bells**—Wood Box, Iron Box, Skeleton, 2½ to 12 inch gongs.

## Push Buttons

In an endless variety of metal and wood finishes.

Pear Shape. Multiple Pushes. Floor and Table Pushes. Gas Lighting. Hard Rubber Midget Pushes. Private Line Cut-outs. Pole Changer Switches. Cotton and Silk Double and Single Tinsel Cord, in red and green.

Also a great variety of miscellaneous supplies, which you will find listed in our special circular quoting prices. If you have not received one of these, send your address at once, as the prices apply only to this Detroit stock, and so long only as it lasts.

BRANCHES:
St. Louis: Southern Electrical Supply Co.
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**Central Electric Company,**
173-175 Adams Street, CHICAGO.

GENERAL WESTERN AGENTS

Okonite Wires, Interior Conduit, Lundell Fans, Helios Arc Lamps, Washington Carbons, Carpenter Enamel Rheostats.

# CHLORIDE WINS!

## INJUNCTION REFUSED.

Judge Green, of the United States Circuit Court, District of New Jersey, on August 27th denied the motion for injunction asked for by the Consolidated Electric Storage Company et al versus the Electric Storage Battery Company. The Electric Storage Battery Company calls attention to the following testimonials which have recently been given to the Chloride Accumulator:

***Professor Chandler, of Columbia College, says:***

"The Chloride Storage Battery is likely to realize all our expectations. Its good qualities include the whole list of qualities that a storage battery can manifest."

***The following is from Professor Barker, of the University of Pennsylvania:***

"I would say that in my judgment this battery has great merit. Among its chief points of excellence, I may mention, first, its high efficiency and large storage capacity; second, its eminent adaptability to commercial needs. I am satisfied that it more nearly fulfills the requirements of modern electric practice than any other storage battery within my knowledge."

***Professor Charles L. Hastings, of Sheffield Scientific School of Yale University, says:***

"The Chloride Accumulator was selected only after careful inquiry concerning all available types. Thus far it has met all our expectations, and promises to fully justify our choice."

***The following is from Mr. A. E. Kennelly:***

"I consider that the principles embodied in its construction make it superior to any storage battery that has yet been placed upon the market in this country."

***Professor Hugh L. Callender, of McGill University, Montreal, says:***

"I have tested the small Chloride Accumulator, type E 5, with results which confirm very nearly the makers' claims with regard to capacity and efficiency. The ampere efficiency of the cell comes out 96.1 per cent.; the watt efficiency, 84 per cent."

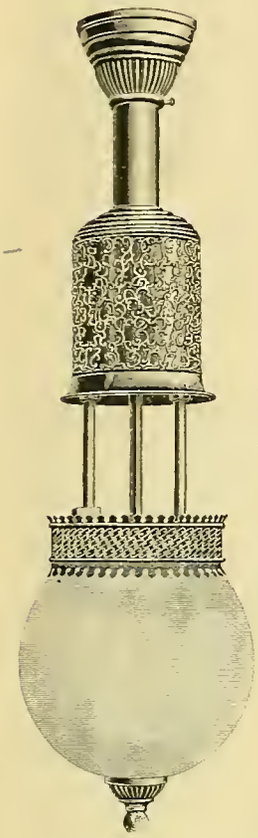
***The following is from letter received from W. K. L. Dickson, of the laboratory of Thomas A. Edison:***

"Your Chloride Accumulator stands unique among its competitors, marking an important stride in the right direction, and being capable of application to varied uses."

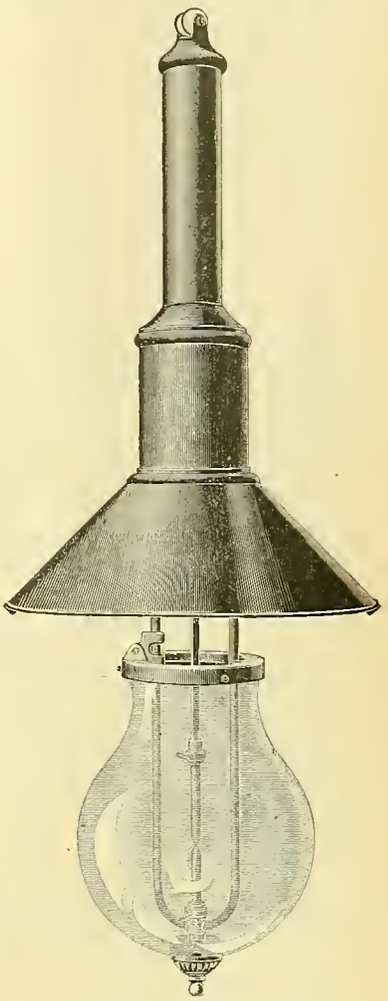
***Professor Houston says:***

"The construction of your Battery involves principles so radically different from that of other prior storage batteries as to cause its invention, in my judgment, to mark an era in the history of the art."

# THE BEST LAMP ON EARTH.



For Direct Current.
For Street Railway Circuits.
For Alternating Circuits.
For Series Arc Circuits.



## NEW AND SUPERIOR.

These lamps are far better than anything manufactured in the line of arc lamps—stronger, simpler, more durable and easier to maintain. They are ALL weatherproof. A trial will convince you of their merits.

**These lamps, both "Twin" and Single, after an exhaustive competitive test, were adopted for use in Brooklyn for low tension street lighting and are now in successful operation.**

We manufacture all kinds of focusing lamps, search lamps, theatrical lamps, stereopticon lamps, and special lamps of any description. In short, if you want ***anything*** in the line of arc lamps, write us before purchasing elsewhere.

We are prepared to furnish promptly ornamental lamps of handsome design, for either direct or alternating current, finished to suit the customer.

# ELECTRIC CONSTRUCTION & SUPPLY CO.,

*Established 1881.*

18 CORTLANDT ST., NEW YORK.

**Wallace Electric Co., Agents, 307 Dearborn St., Chicago, Ill.**

# THE C & C ELECTRIC COMPANY

MANUFACTURERS OF

## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

General Office:
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Works: GARWOOD, N. J.
on CENTRAL R. R. of N. J.

BRANCH OFFICES: CHICAGO, 1020 and 1021 Monadnock Building. BOSTON, 63 Oliver St.
CLEVELAND, Cuyahoga Building. PHILADELPHIA, 633 Arch St.

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# THE EDDY PATENT SELF-LOCKING WINDLASS

## For Raising and Lowering Arc Lamps.

Before buying it will well repay your time to investigate the Eddy Windlass. We challenge the world for its equal. A mechanical perfection. No complicated parts. Made of practically three castings. Will last a lifetime. Remember that it cannot be left unlocked, and that the crank is the only key that will unlock it. Cannot be tampered with. It is sleet-proof. Always ready to operate quickly. Send for descriptive circular.

S. E. WHITEHEAD,
General Agent for the U. S., Carthage, Mo.

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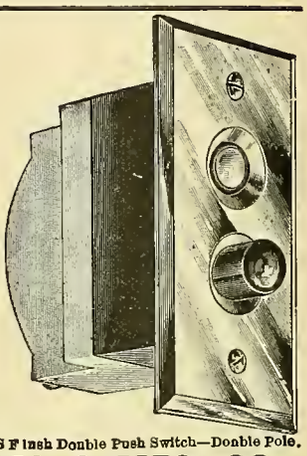
# C-S SPECIALTIES.



**C-S Flush Double Push Switch.**
Single Pole—Double Pole—Commutation; 3 Wire, 4 Wire.

**C-S Flush Key Switch.**
Single Pole—Double Pole—3 Wire.

**C-S Flush Automatic Switch.**
Single Pole.

ELECTRICALLY
MECHANICALLY
ARTISTICALLY
**PEERLESS.**

C-S Flush Double Push Switch—Double Pole.

## THE CUTTER ELECTRICAL & MFG. CO.,

*27 So. 11th Street, Philadelphia, Pa., U. S. A.*

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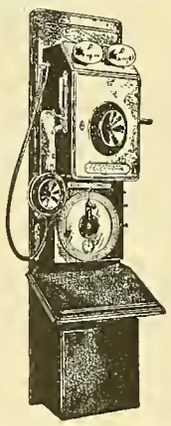
STEPHEN B. ELKINS, Prest. PATRICK EGAN, Sec'y. H. J. HANFORD, Gen'l Mgr.

# The Harrison International Telephone Co.



AGENTS' TERRITORIES NOW BEING ALLOTTED.

WRITE AT ONCE.

**WHAT MONEY CAN EARN AND THE PEOPLE SAVE BY MEANS OF THE**

## Harrison International Telephone.

**We either sell our telephones outright or lease them for a term of years.**

This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Patent No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete electric speaking telephone operated by battery; and owns Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

Prospectuses furnished by eddressing the Company at their offices,

Offices, Chamber of Commerce Bldg., Chicago.

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VULCABESTON

## HEAT-PROOF INSULATION.

The Standard Insulating Material for Controller Parts, Magnet Spools, Bushings, Washers, Insulating Sheets for Lining Cut-out Boxes, Etc., Etc.

## MOULDED MICA TROLLEY LINE INSULATORS.

Some of the largest orders ever placed for line materials have been for Moulded Mica.

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*240 and 242 Randolph Street, CHICAGO, ILL.*

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# THE MATHER ELECTRIC COMPANY,

## Manchester, Conn.

## Power Generators for Lighting and Railway Purposes.
## Complete Station Equipments.

Mather Apparatus for sale exclusively in their respective territories by the following well-known and reliable Contractors:

## J. HOLT GATES, 1140 Monadnock Building, Chicago, Western Contractor.

H. B. COHO & CO., 203 Broadway, New York: New York City, Brooklyn and vicinity and New Jersey.
G. M. ANGIER & CO., 116 Bedford St., Boston, Mass.: New England.
S. N. BLAKE, Elmira, New York: Northern and Western New York.

# SOMETHING NEW.

WIRES AND CABLES

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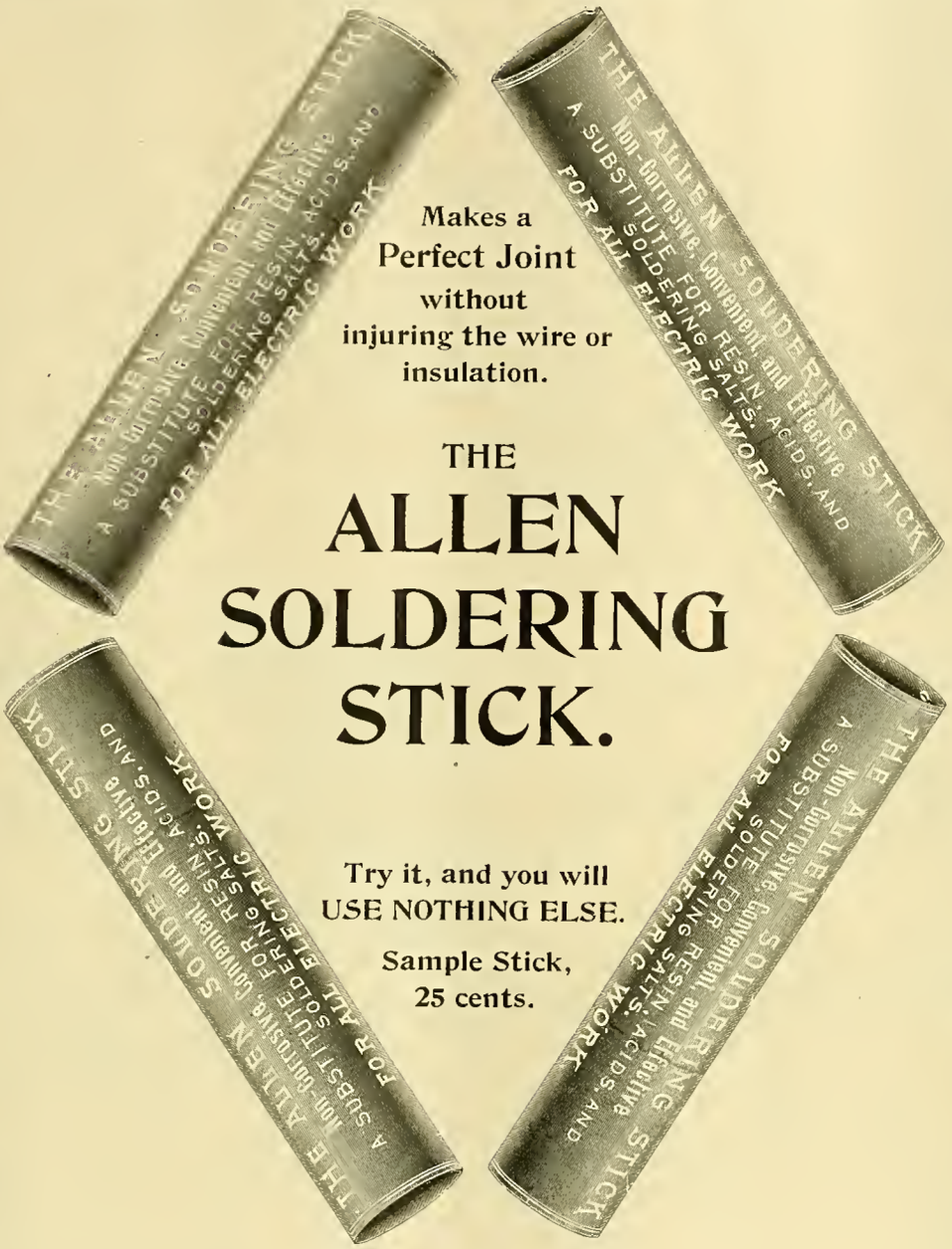



Makes a
Perfect Joint
without
injuring the wire or
insulation.

## THE ALLEN SOLDERING STICK.

Try it, and you will
USE NOTHING ELSE.

Sample Stick,
25 cents.

# Electric Appliance Company,

ELECTRICAL SUPPLIES.

**242 MADISON STREET, CHICAGO.**

GENERAL WESTERN AGENTS

Paranite Wires and Cables, "O. K." Weatherproof Wires and Cables.

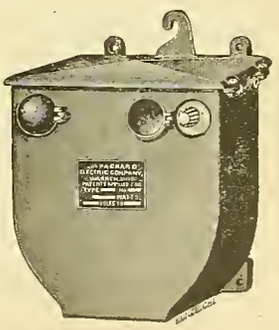
AND REPRESENTING

NEW YORK & OHIO COMPANY, Warren, Ohio,

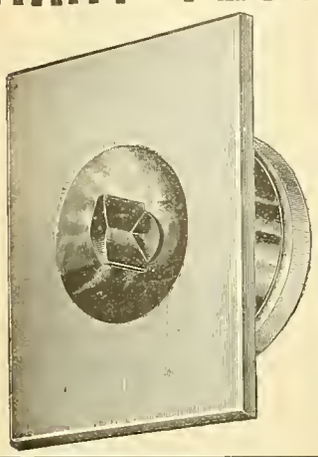
MANUFACTURERS OF THE PACKARD LAMP;

PACKARD ELECTRIC COMPANY, Warren, Ohio,

MANUFACTURERS OF THE PACKARD TRANSFORMER.



# HART FLUSH SWITCHES.



5 and 10 Ampere Single Pole.
10 Ampere Double Pole.
10 Ampere Three-way.

The Only Snap Switch that has

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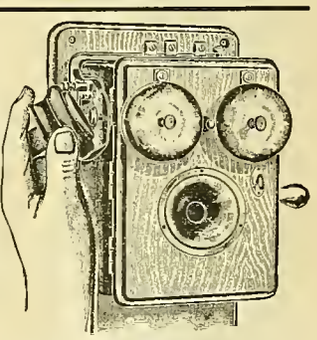

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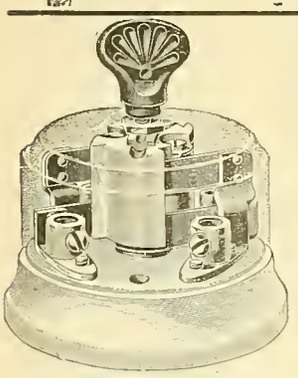

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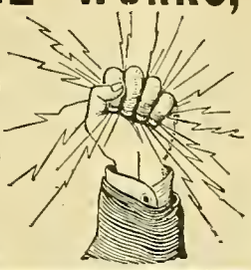

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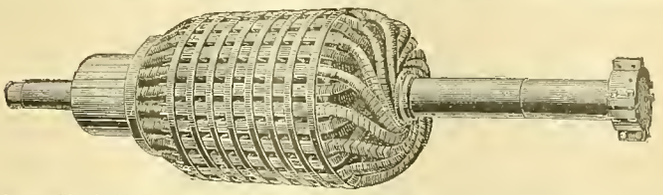

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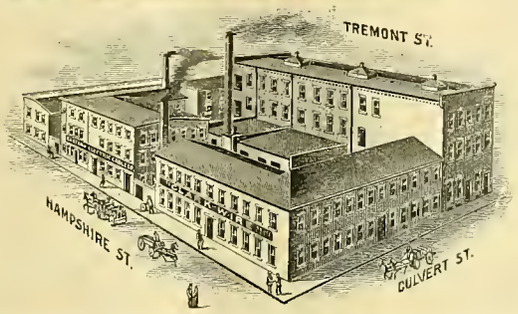


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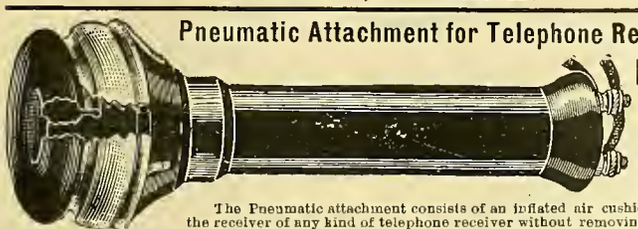

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Improves the hearing 25 per cent.

The Pneumatic attachment consists of an inflated air cushion, clasped to the receiver of any kind of telephone receiver without removing or altering same in any way. It increases the hearing for the reason that, being pneumatic, when placed to the ear it conforms to its shape, concentrates the sounds, and no sound can escape from the receiver; also excludes all exterior sounds. Any induction noise or buzzing sounds coming from the wires cannot affect the hearing, as the Pneumatic Attachment, being made of springy substance, when pressed to the ear regulates the distance of the receiver from the ear drum and avoids concussion of the ear. Address V. A. COOK, Averill Park, N. Y.

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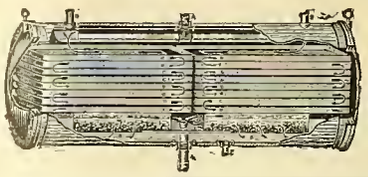

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Two 50-light Western Electric Arc, ten ampere, 2,000 C. P. Dynamos
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Two Iron Stacks.

All of the above machinery is as good as new. Will be sold cheap. For particulars address

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DEPARTMENT OF THE INTERIOR,
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JNO. M. REYNOLDS, Acting Secretary.

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The D'Unger Telephone (its reputation as the best instrument ever constructed now fully established) is the *only* instrument in which the *power of the voice* is increased; the *only* instrument in which *the electric current is intensified* by the action of the voice; the *only* instrument in which *the voice-wave is reduced.* No telephone can be built with these wonderful advantages *without the use of a lever.* The D'Unger Long-Distance Telephone Company has *the sole and exclusive right to use a lever in telephones—remember that.*

These instruments are supplied to exchanges and toll lines on a small annual royalty. They cannot be had on any other terms.

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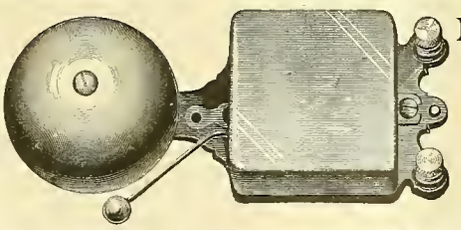

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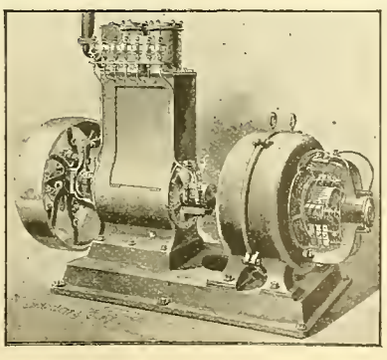

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A thorough business man and engineer, who has had experience in putting gas and electric plants on a paying basis, would like to lease a gas, electric light or railway plant, or will take the management of any of the above for a percentage of the profits. Address, **Montana,** Care WESTERN ELECTRICIAN, 6 Lakeside Bldg., Chicago.

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Position wanted as superintendent or electrician of electric light plant. Have had technical training and five years' experience in construction and station work. Good references. Address "AMERICAN,"
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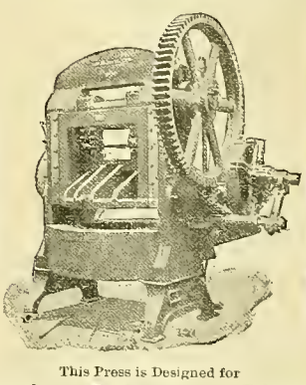

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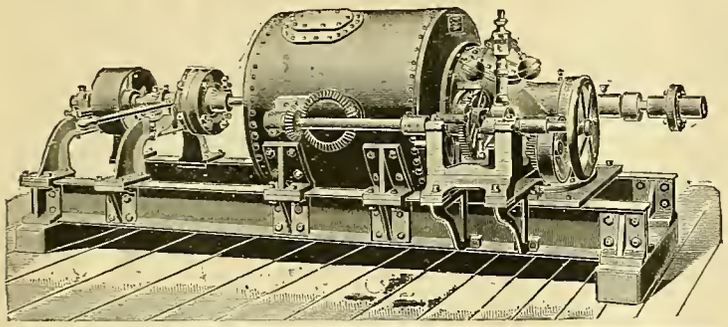

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The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter**, being **double the power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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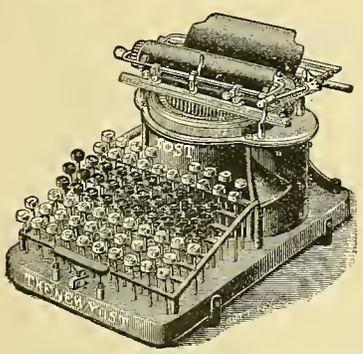

Constructed on principles radically its own, insuring results always sought for but absolutely unattainable in the construction of any other machine. It is pre-eminently the telegrapher's and professional stenographer's typewriter.

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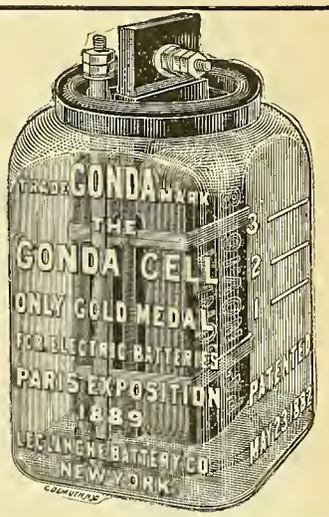


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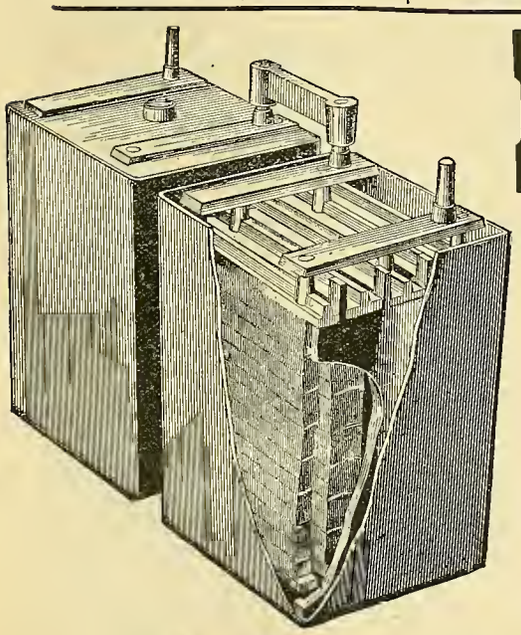

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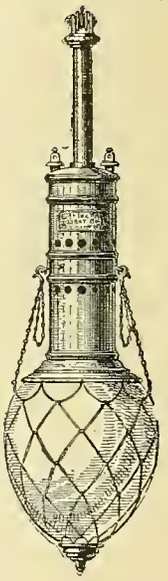

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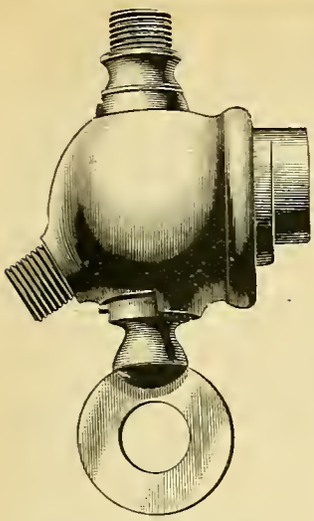

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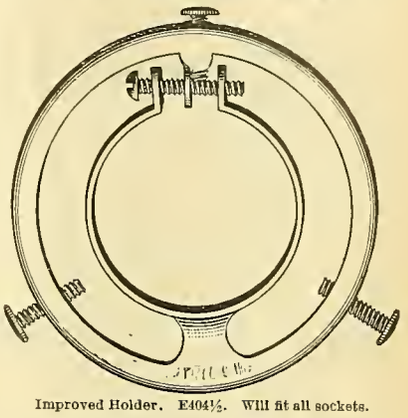

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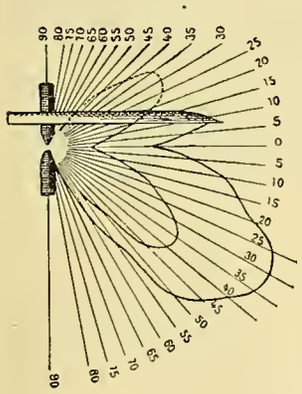

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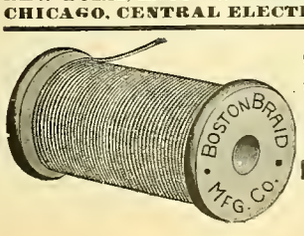


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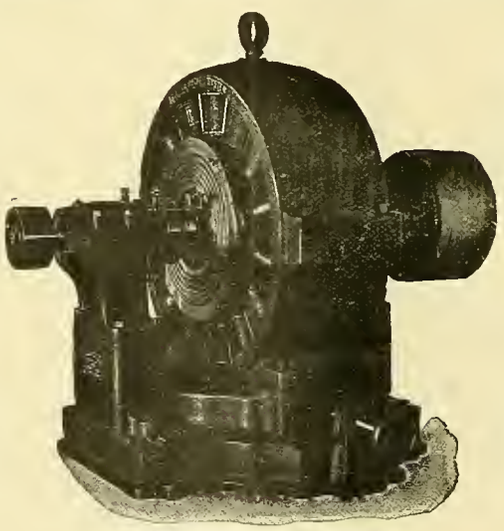

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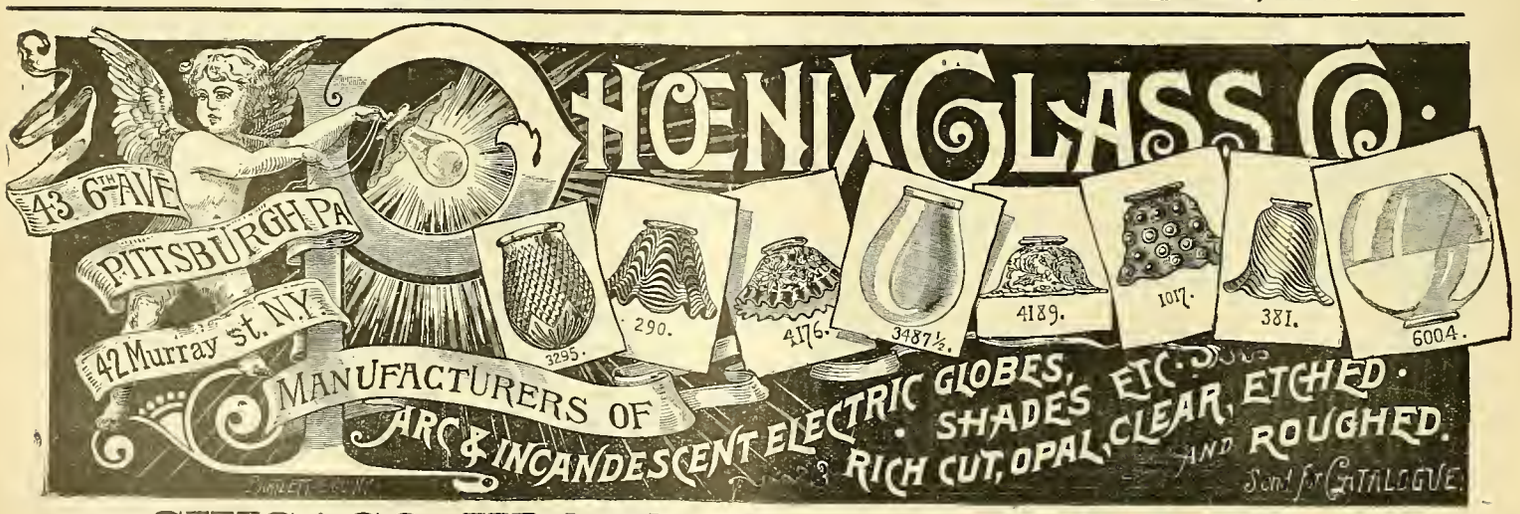


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I find the amount of:

| | | | | | |
|---|---|---|---|---|---|
| Ammonium Chloride | contained | therein | to be | 99.51 | per cent. |
| Ammonium Sulphate | " | " | " | 0.03 | " |
| Moisture | " | " | " | 0.13 | " |
| Non-Volatile Matter | " | " | " | 0.02 | " |
| Organic Matter | " | " | " | 0.31 | " |

The Non-Volatile Matter consists of Iron Oxide and Alumina.

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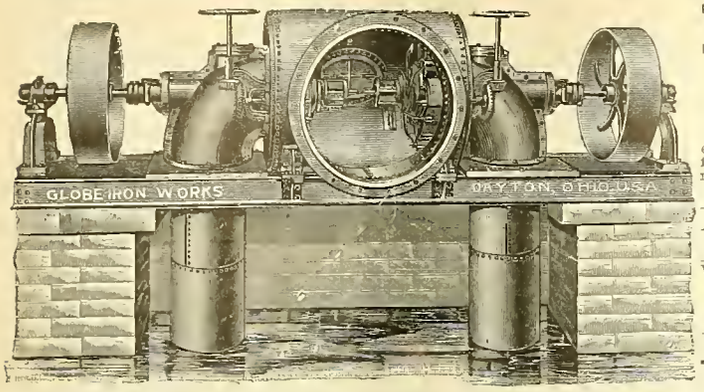


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|---|---|---|---|---|---|
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| ⅞ " | 16.42 | 122.00 | 127.18 | 195 19 | 82.58 |
| ¾ " | 16.78 | 117.33 | 112.60 | 175.74 | 82.18 |
| ⅝ " | 17.03 | 111.83 | 98.12 | 149.99 | 79.31 |
| ½ " | 16.88 | 116.67 | 82.07 | 118.40 | 75.52 |

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| | Head. | Rev. per Min. | Cu. Ft. per Sec. | Horse Power. | P'r Cent |
|---|---|---|---|---|---|
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| ⅞ " | 16.66 | 134.80 | 120.85 | 188.14 | 83.09 |
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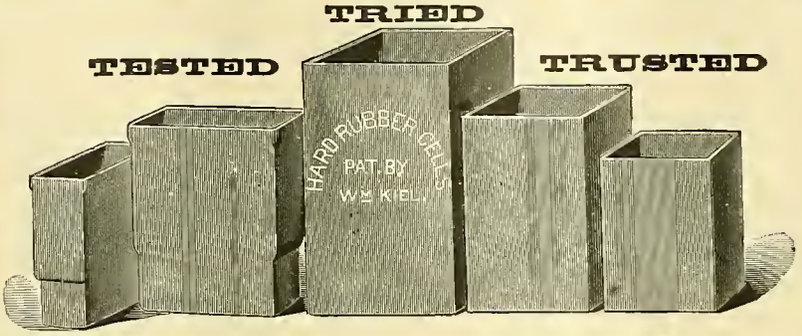


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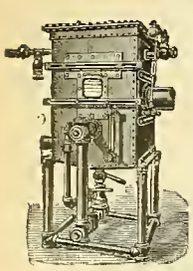

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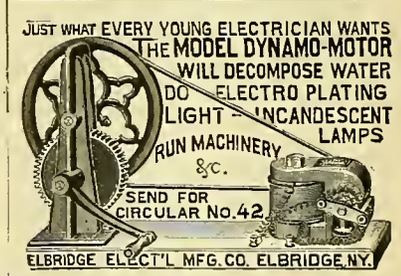


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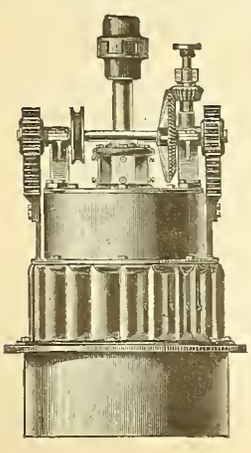

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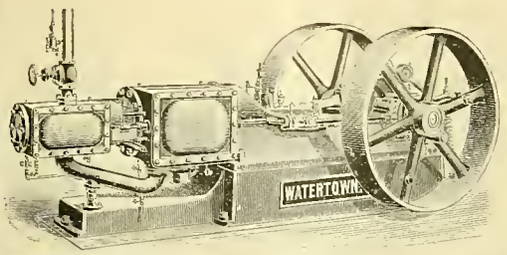

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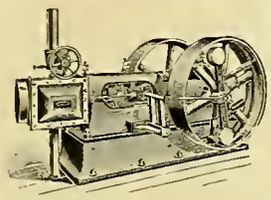

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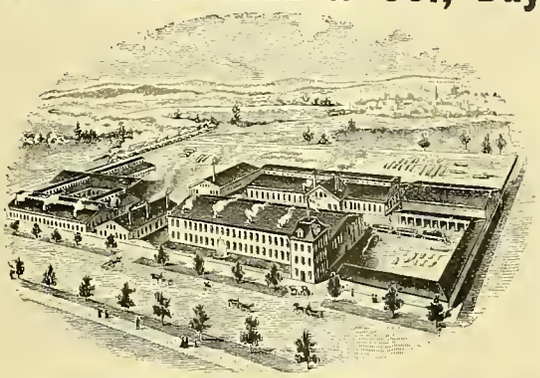

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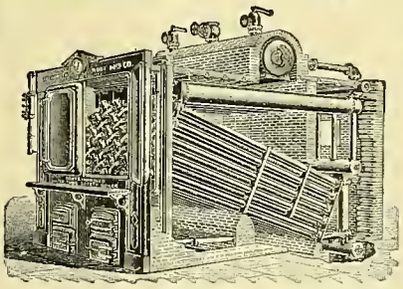

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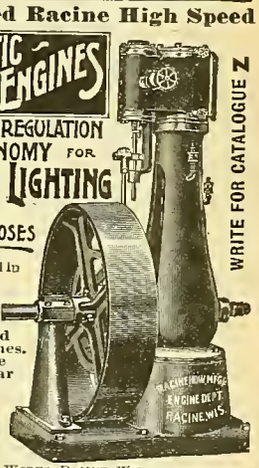

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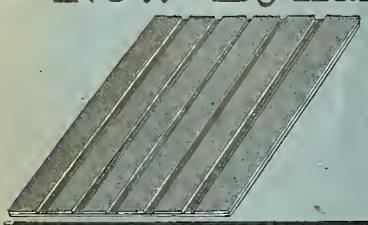

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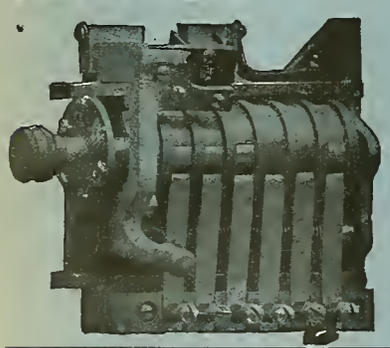

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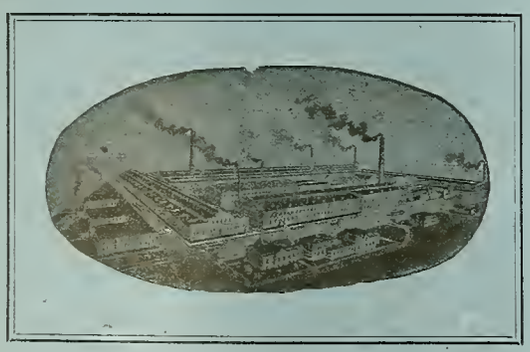

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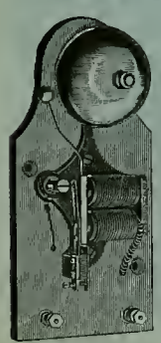

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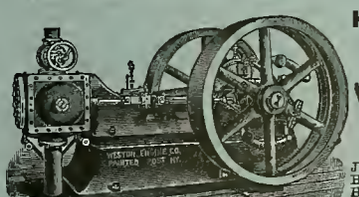

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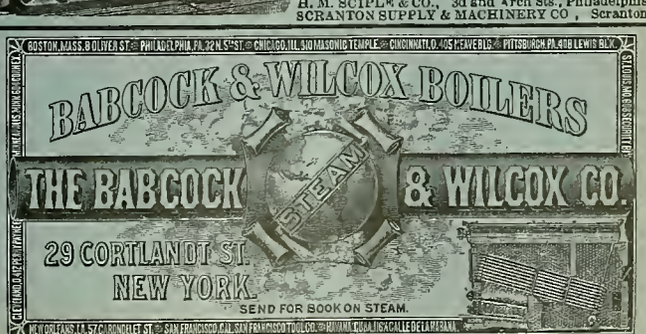


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Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Sioux City Brass Works
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Electric Railways.**
Brush Electric Co
General Electric Co.
Hubley Mfg. Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Cameron & Gillett.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Roberts & Co., E. P.
Rushmore, S. W.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Greeley & Co., The E. S.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
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Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
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General Electric Co.
Rushmore, S. W.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng. & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Engravers.**
Illinois Engraving Co.

**Fan Outfits**
Bolgiano Mfg. Co.
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Interior Conduit & Ins. Co.
Muncie Elec. Mfg. Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
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Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
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Western Electric Co.

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Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.

**Gears**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. Supplies.**
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Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Greeley & Co., The E. S.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Rushmore, S. W.
Palmer Bros.
Porter & Buerdorf.
Sioux City Brass Works.
Washington Electric Co.
Western Elec. Supply Co.

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Empire China Works.
Hart & Hegeman Mfg. Co.
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Holtzer-Cabot Electric Co.
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Jennings, A. R.
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Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Hubley Mfg. Co.
Independent Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

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Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
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Sioux City Brass Works.
Stanley Elec. Mfg. Co.
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Phillips Insulated Wire Co.
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Greeley & Co., The E. S.
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Electric Appliance Co.
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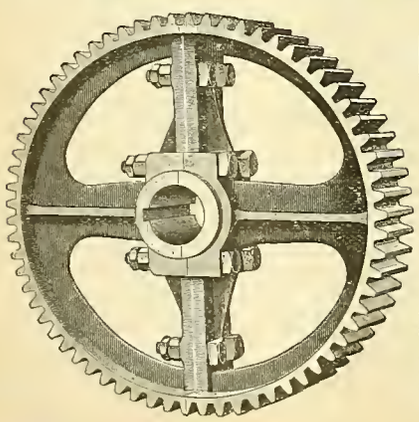

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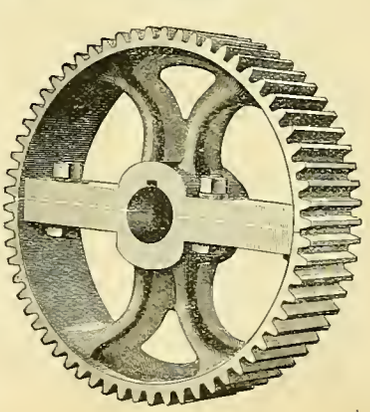
TRY IT ONCE, AND YOU WILL WANT NO OTHER.



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# Central Electric Company,

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Chicago, Ill.

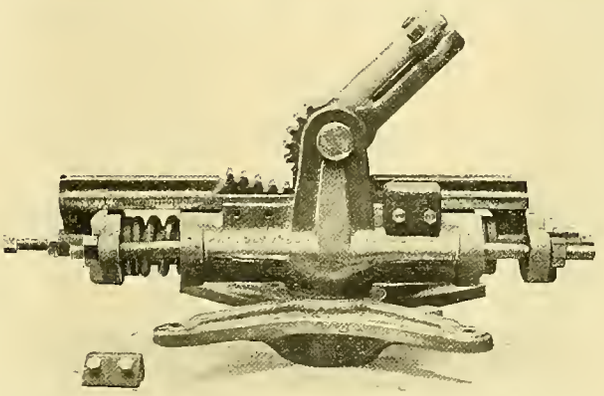
The Falk Trolley.

**The Trolley Wheel and Harp** which we illustrate here, is one that has met with general approval wherever used. It is of **simple construction** and **few parts,** but embodies an economic feature that belongs to no other wheel. It has case hardened **steel cone bearings,** arranged in such manner that while they allow a perfectly free revolution of the wheel, there can be no wabbling, rattling or side movement. A coiled spring contained *inside* the harp frame keeps the cones true to the bushings.

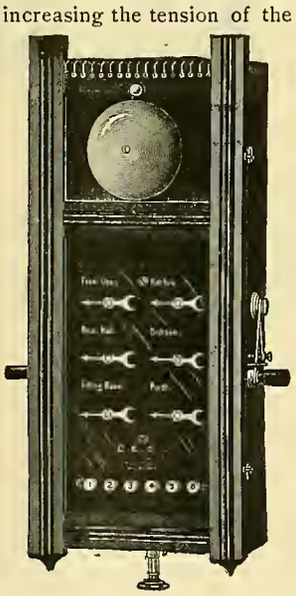
This entire device is made of the best steel. We consider the deep grooved steel wheel much superior to brass or bronze, but will supply them if preferred by customer. The wheel can be detached from harp in one minute for inspection or repairs. **An improved feature** is the "dope" chamber inside the wheel. This will hold sufficient lubricant to last many miles of travel. Thirty cars can be inspected and oiled in ninety minutes. No grease or oil will drip or leak out.

**Let us send you a sample for trial and comparison with any other wheel you have in use.**

## The Chicago Trolley Base



Is substantially built, omitting everything not essential to strength and perfect operation of the parts. THE TROLLEY ARM can be pulled down flat on the car top without increasing the tension of the spring. This relieves it of the catapult feature of all other bases. The castings are of malleable iron, smooth finish and painted.



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**In Our House Goods Department** we have several hundred annunciators, in assorted sizes and various wood finishes.

We are making a particularly LOW PRICE on the Detroit Burglar Alarm Annunciator. Don't neglect to send your name for one of the special lists mentioned last week.

*Orders and correspondence given prompt attention.*

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**Okonite Wires, Interior Conduit, Lundell Fans, Helios Arc Lamps, Washington Carbons, Carpenter Enamel Rheostats.**


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173-175 Adams Street,
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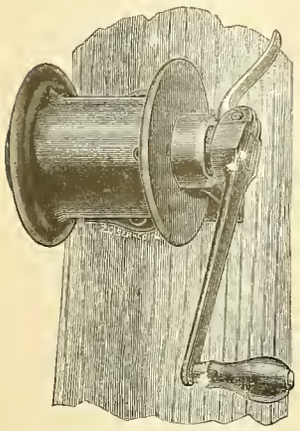
# THE EDDY PATENT SELF-LOCKING WINDLASS



WINDLASS UNLOCKED.

For Raising and Lowering Arc Lamps.

Before buying it will well repay your time to investigate the Eddy Windlass. We challenge the world for its equal. A mechanical perfection. No complicated parts. Made of practically three castings. Will last a lifetime. Remember that it cannot be left unlocked, and that the crank is the only key that will unlock it. Cannot be tampered with. It is sleet-proof. Always ready to operate quickly. Send for descriptive circular.

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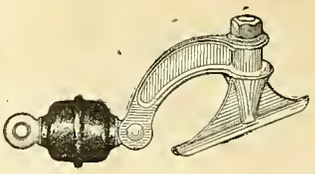

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Designed with reference to strength, durability, high insulation, reliability and practical fitness for the work they have to do. In universal use.

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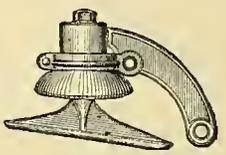

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New Prices given on Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters

And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.

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*Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.*

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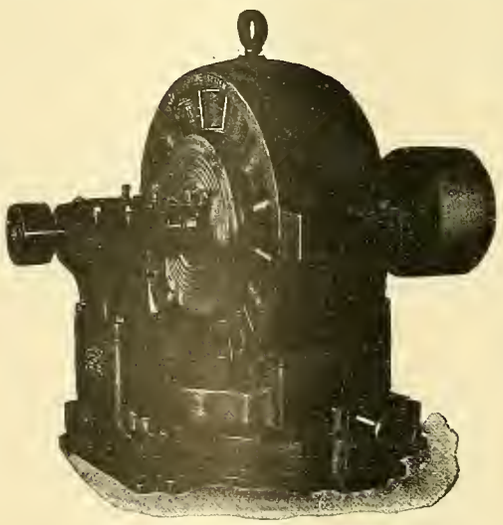
MANUFACTURED IN SIZES FROM

*25 to 5,000 Lights,*

SINGLE OR MULTIPHASE.

Direct Connected Dynamos.

Direct Current Generators.



1,000 Light Alternator.

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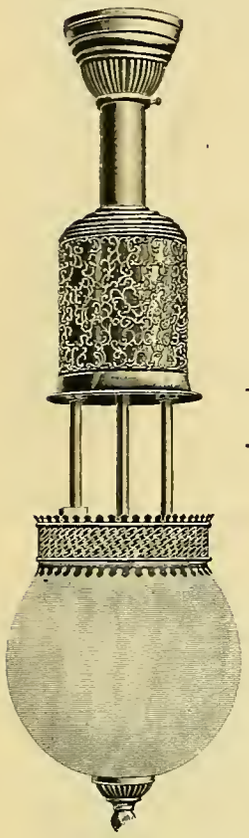
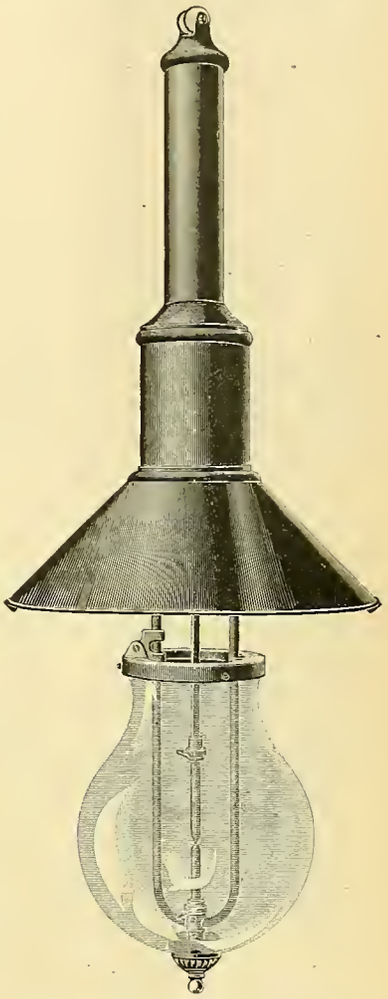


For Direct Current.
For Street Railway Circuits.
For Alternating Circuits.
For Series Arc Circuits.



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These lamps are far better than anything manufactured in the line of arc lamps—stronger, simpler, more durable and easier to maintain. They are ALL weatherproof. A trial will convince you of their merits.

**These lamps, both "Twin" and Single, after an exhaustive competitive test, were adopted for use in Brooklyn for low tension street lighting and are now in successful operation.**

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We are prepared to furnish promptly ornamental lamps of handsome design, for either direct or alternating current, finished to suit the customer.

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*Established 1881.*

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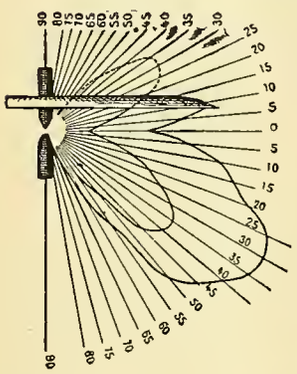

# Reflector Plate Alternating ARC LAMPS.

We claim better distribution of light than any other alternating lamp in the market. We accomplish this by means of **OUR REFLECTOR PLATE.**

We claim that we can obtain more economy than any other alternating lamp in the market. We do this by means of the **SPENCER ECONOMY COIL.**

We will beat the market for prices on Helios carbons this fall.

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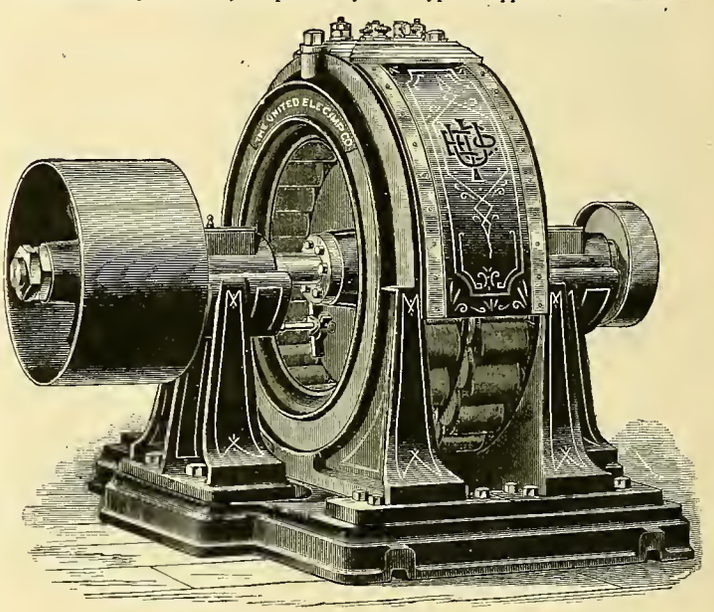
# Alternating Current Generators,

**For Central Station Equipment.**

Adapted for Arc and Incandescent Lighting.
Gnaranteed Equal in Every Respect to any other Type of Apparatus Manufactured.



Slow Speed and Close Regulation.

Standard of Simplicity and Durability.

**ALSO**

Direct Current Apparatus for Lighting Factories, Public Buildings and Isolated Plants.
Improved Long Distance Series Incandescent Apparatus for Street and Commercial Illumination.
Incandescent Lamps and Sockets for use on Arc Light Circuits.

**Correspondence Solicited.**

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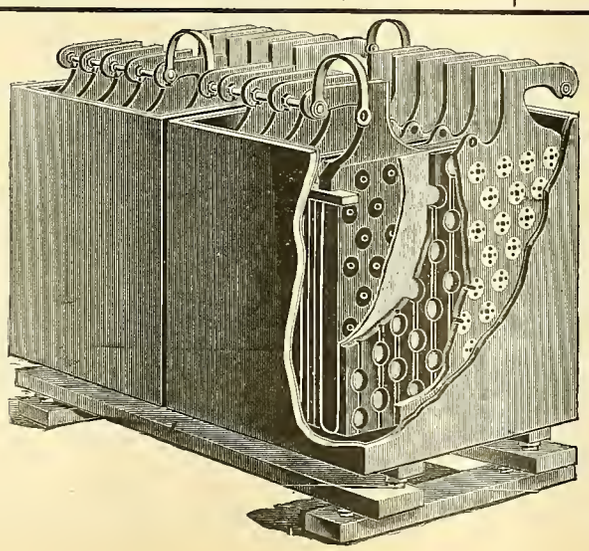

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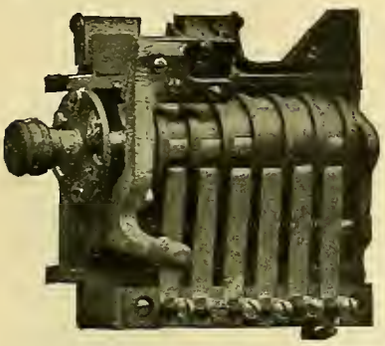

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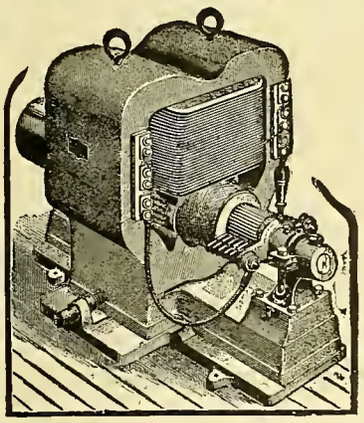

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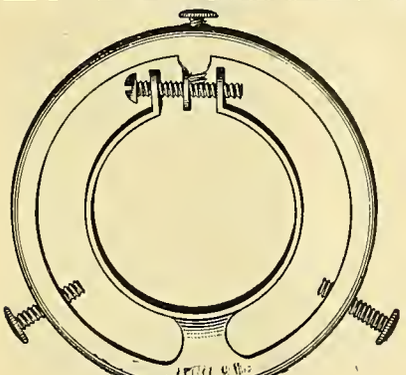

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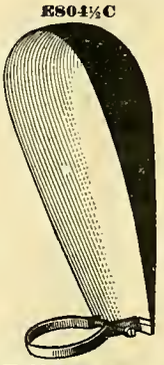

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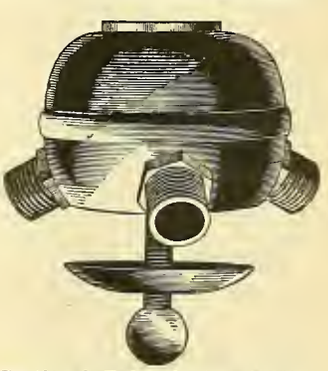

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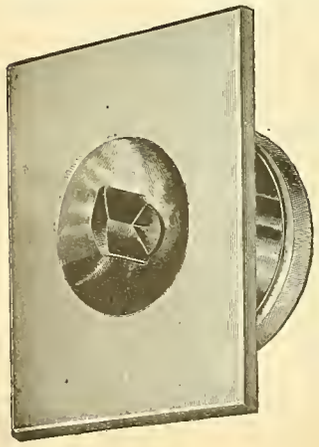

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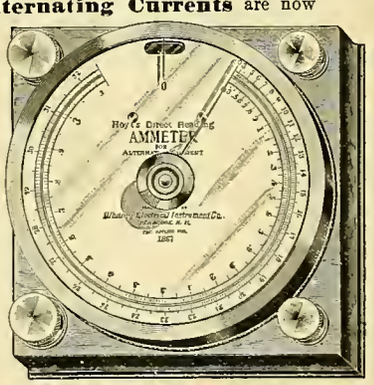


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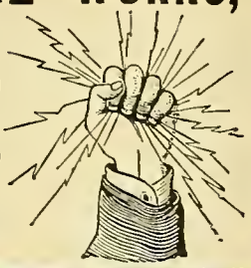

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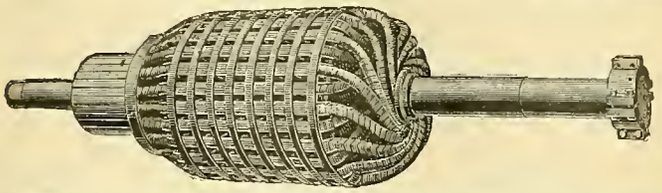

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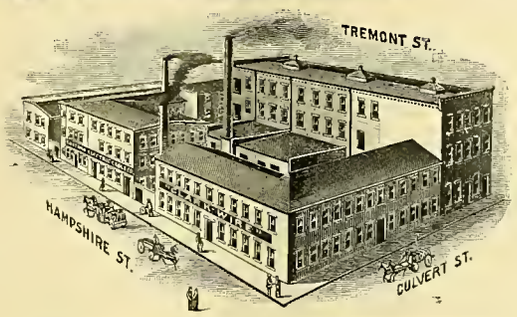


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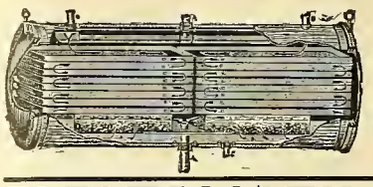

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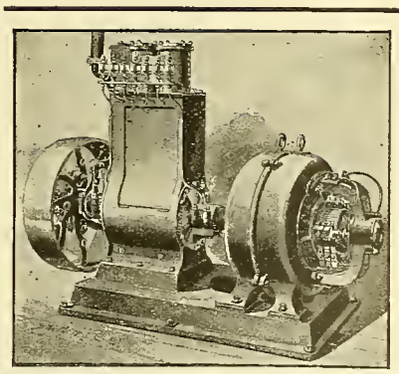

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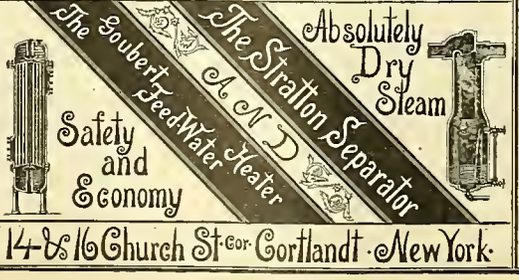


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DEPARTMENT OF THE INTERIOR,
WASHINGTON, D. C., August 25, 1894.

Sealed proposals (in duplicate) will be received at the Department of the Interior until 3 o'clock p. m. Monday, September 24, 1894, for the construction of a Telephone Exchange System for the Department of the Interior and at the same time and place proposals will also be received for the extension and modification of the present Telephone System of the Interior Department. Bids must be made on Government blanks. Blank forms of proposal, specifications, etc., may be obtained on application at the office of the Chief Clerk of the Department, where drawings showing details may also be inspected. All proposals received will be opened at the time and place above stated, and bidders are invited to be present at such opening.

JNO. M. REYNOLDS, Acting Secretary.


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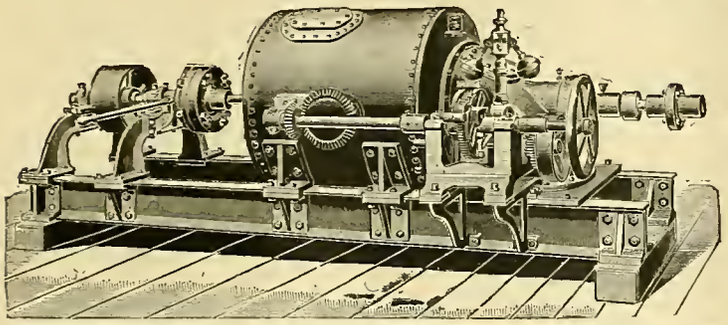

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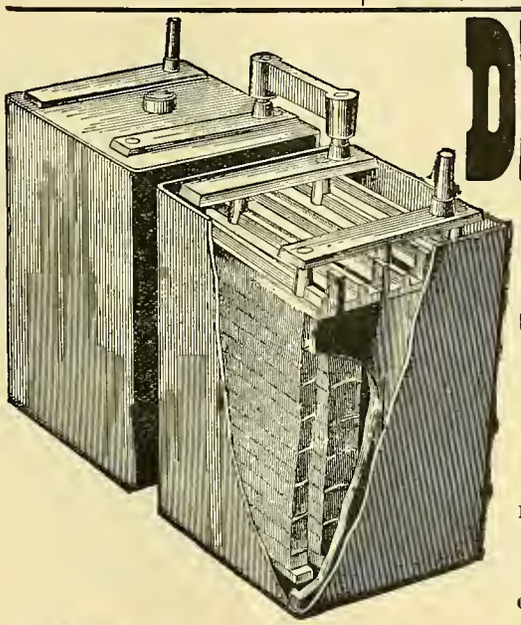

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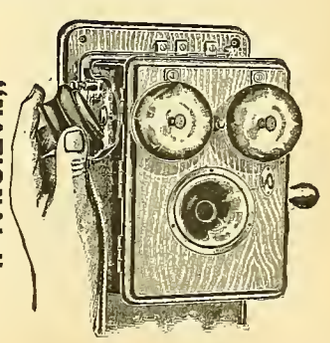

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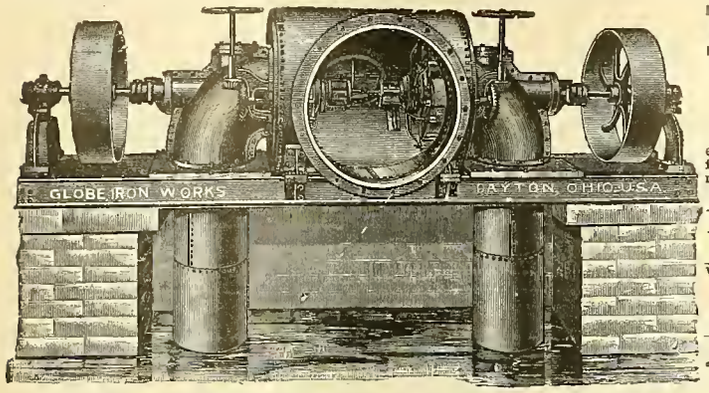


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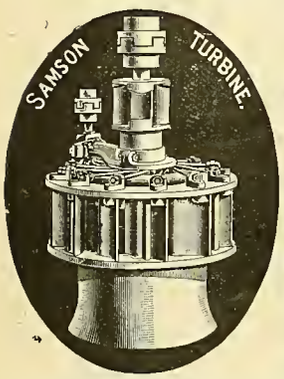


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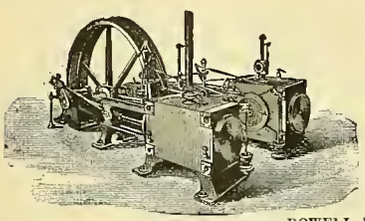

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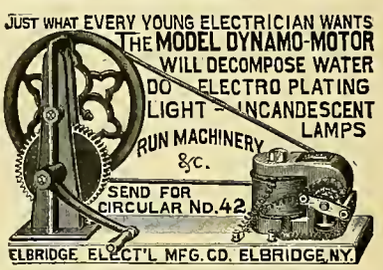


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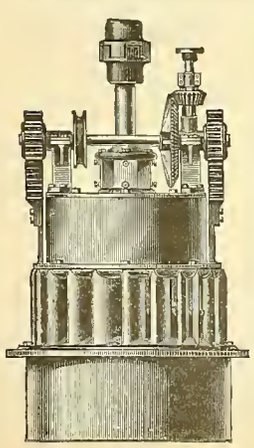

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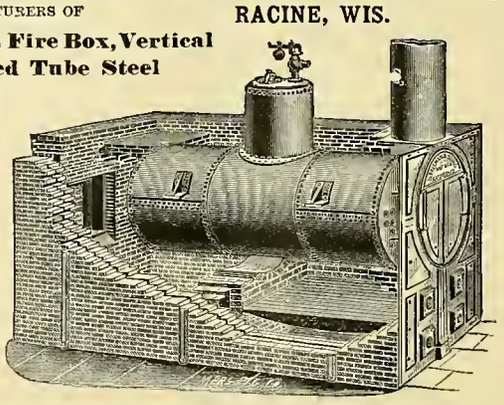

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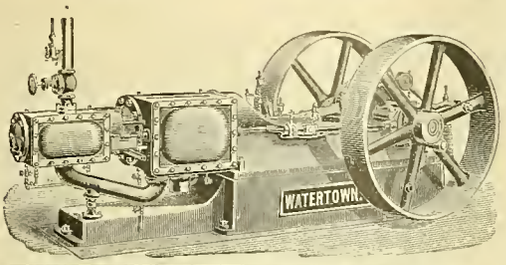


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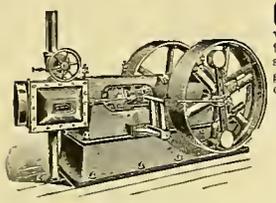

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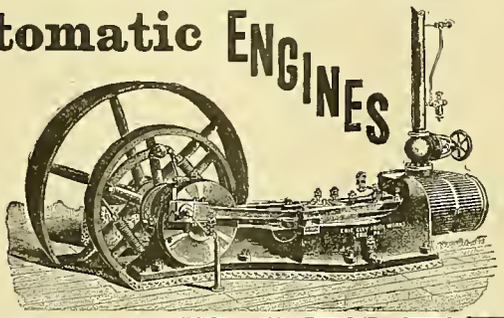

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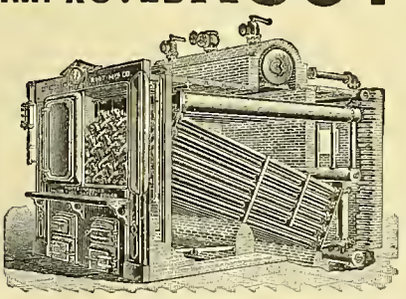

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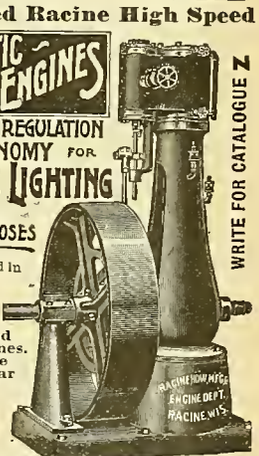

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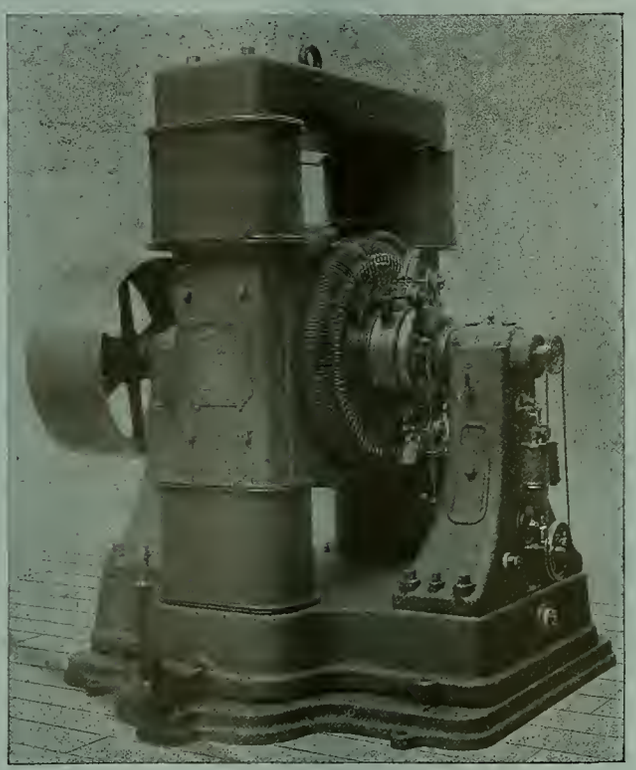

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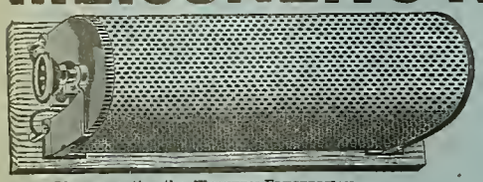

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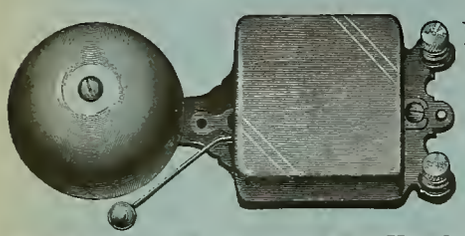

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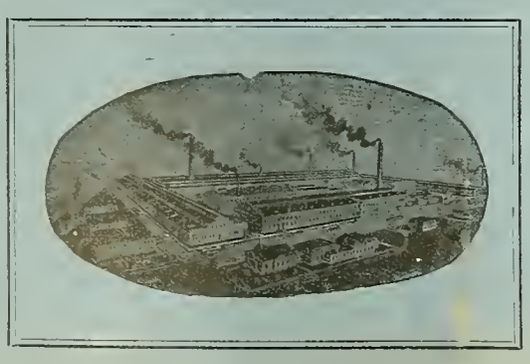

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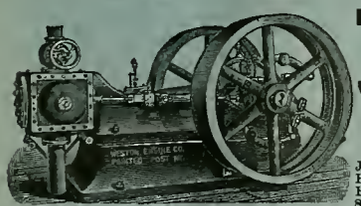

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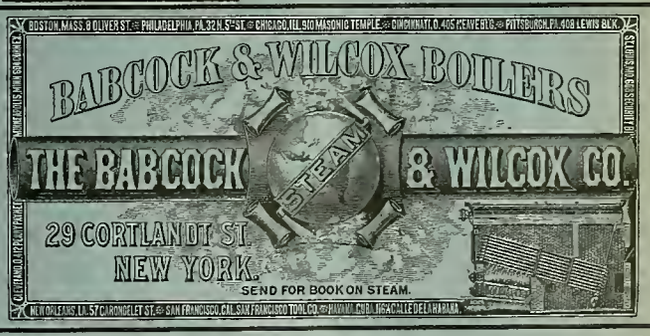


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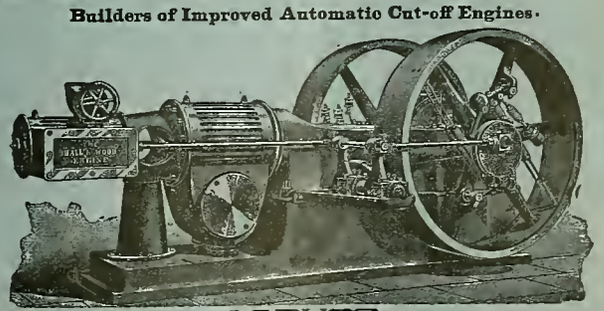

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## CLASSIFIED LIST.


**Accumulators.**
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co
Porter & Buerdorf.

**Annunciators.**
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Applisnce Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Central Electric Co.
Electric Appliance Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Hayden-Booker Mfg. Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Washington Electric Co.
Western Electric Co.

**Belting.**
Shultz Belting Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co, The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Fulton Steam Boiler Wks.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electrician Publishing Co.

**Brushes.**
Partridge Carbon Co.
Wirt, Chas.

**Burglar Alarms.**
Central Electric Co.
Electric Appliance Co.
Metropolitan Electric Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric.** (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Chicago Ins. Wire Co.
Cushing & Morse.
Eastern Electric Cable Co.
Hill, W. S. Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co, J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons, Points & Plates.**
Central Electric Co.
General Electric Co.
Jennings, A. R.
Metropolitan Electric Co.
Partridge Carbon Co.
Reisinger, Hugo.
Western Electric Co.

**Car-Heaters, Electric.**
Consolidated Car-Heating Co.

**Castings.**
Dutcher Co., J. A. & P. E.

**Clocks, Electric.**
Self-Winding Clock Co.

**Conduits**
Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Bussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Muncie Elec. Mfg. Co.
Washington Electric Co.
Wirt, Chas.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co
Muncie Elec. Mfg. Co.
Roberts & Co., E. P.
Rushmore, S. W
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co, J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Chicago Ins. Wire Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co. The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Electric Appliance Co.
Hubley Mfg. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegaman Mfg. Co.
Hill, W. S. Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Sioux City Brass Works.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Electric Railways.**
Brush Electric Co
General Electric Co.
Hubley Mfg. Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. B.
Cameron & Gillett.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Roberts & Co., E. P.
Rushmore, S. W.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co, The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Engravers.**
Illinois Engraving Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Central Electric Co.
Interior Conduit & Ins. Co.
Muncie Elec. Mfg Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Bard Rubber Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. Supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. B.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Caoot Electric Co.
Bubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Palmer Bros.
Porter & Buerdorf.
Sioux City Brass Works.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Hubley Mfg. Co.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.
Hubley Mfg. Co.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Insulators and Insulating Materials.**
Anderso , Albert & J. M.
Bernard Co., The E. G.
Runnell & Co., J. B.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
Bill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Munsell & Co.. Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Vulcanized Fibre Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. B.
Central Electric Co.
Chicago Ins. Wire Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Hubley Mfg. Co.
Independent Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co , J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Jennings, A. R.
Mather Electric Co.
Metropolitan Electric Co.
New York & Ohio Co.
United Elec. Imp. Co.
Westinghouse Elec & Mfg. Co.

**Lightning Arresters.**
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Bill, W. S. Electric Co.
Wirt, Chas.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery.**
Bliss Co., E. W.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

**Motors.**
Bolgiano Mfg. Co.
Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co.

**Packing.**
Garlock Packing Co.

**Paints.**
Standard Paint Co.

**Phosphor Bronze.**
Phosphor Bronze Sm. Co. Ltd

**Platinum.**
Baker & Co.

**Poles.**
Brownlee & Co.
Morris, Tasker & Co.
Nuttall Co., R. D.

**Porcelain.**
Empire China Works.
Chicago Gen'l Fixture Co.
General Electric Co.
Phœnix Glass Co.

**Publishers, Electrical.**
Electrician Publishing Co.

**Push Buttons.**
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.

**Rheostats.**
General Electric Co.
Rushmore, S. W.

**Sal Ammoniac**
Bayden-Booker Mfg. Co.
Klipstein, A. & Co.
Law Battery Co.

**Second-Hand Electrical Machinery.**
Gregory, Chas. E. Co.
Rushmore, S. W.

**Separators.**
Goubert Mfg. Co.

**Silk Braid.**
Roston Braid Mfg. Co.

**Slate.**
Independent Electric Co.
Jennings, A. R.

**Speaking Tubes.**
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.

**Speed Indicators**
Whitney Elec. Instrument Co

**Steam Heating.**
Gonbert Mfg. Co.
Webster & Co., Warren.

**Steam Pumps.**
Worthington, Henry R.

**Storage Batteries.**
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Porter & Buerdorf.

**Stoves, Electric.**
Consolidated Car-Heating Co.

**Street Cars.**
Brill, J. G. Co.

**Tapes, Insulating.**
American Electrical Works.
Central Electric Co.
Cushing & Morse.
Chicago Ins. Wire Co.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
Central Electric Co.
Electric Appliance Co.
Metropolitan Electric Co.
Western Electric Co.

**Telephones,**
D'Unger Long Dist. Tel. Co
Harrison Int. Telephone Co.
Imperial Telephone Wks.
Metropolitan Electric Co.
National Telep. Mfg. Co.
Palmer Bros.
Western Electric Co.
Western Tel. Const. Co.

**Telephone Hooks.**
Bradley & Co.

**Transformers.**
General Electric Co.
Hornberger Elec. Mfg. Co
Ft. Wayne Elec. Corporation
Jennings, A. R.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Trucks, Electric Car.**
General Electric Co.
Westinghouse El. & Mfg. Co.

**Turbine Wheels.**
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

**Universities.**
Cor. School of Industrial Sciences.
Correspondence School of Technology.
Scientific Machinist Co.

**Varnishes.**
Standard Paint Co.

**Water Wheels.**
Leffel & Co., Jas.
Smith, S. Morgan.

**Windlasses.**
Whitehead, S. E.

**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co,
Central Electric Co.
Electric Appliance Co.
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.

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# Power Transmission

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**WE ARE PREPARED TO FILL ALL ORDERS PROMPTLY AND CARRY A FULL STOCK OF TRANSFORMERS IN CHICAGO.**

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# R. D. NUTTALL COMPANY, Allegheny, Pa.

F. A. ESTEP, President and Treasurer.
J. R. McGINLEY, Vice-President.
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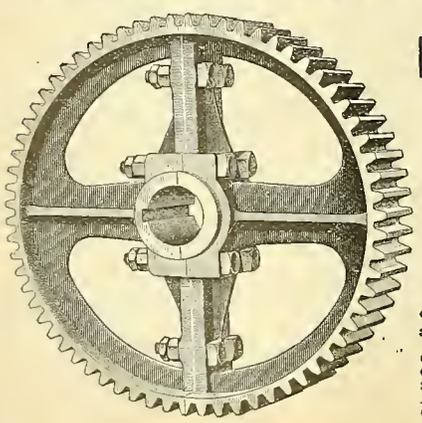

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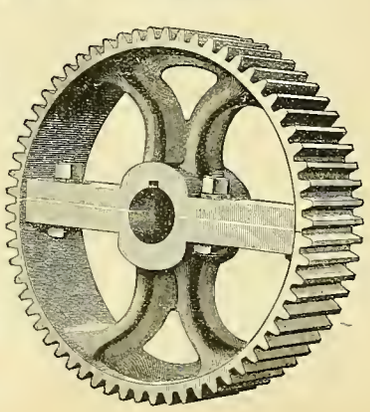
THIS IS THE IMPROVED NUTTALL TROLLEY.

TRY IT ONCE, AND YOU WILL WANT NO OTHER.



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A. S. PARTRIDGE, Bank of Commerce Building, St. Louis, Mo., S. W. States Sales Department.
CHAS. A. CAVAGNA, Neave Building, Cincinnati, Ohio, Central States Sales Department.

# Central Electric Company,

173-175 Adams Street,
Chicago, Ill.

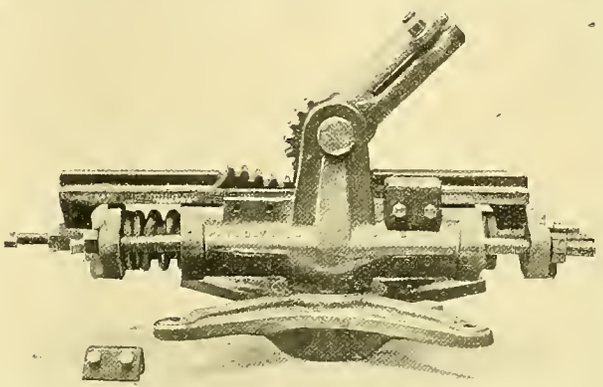
The Falk Trolley.

**The Trolley Wheel and Harp** which we illustrate here, is one that has met with general approval wherever used. It is of **simple construction** and **few parts**, but embodies an economic feature that belongs to no other wheel. It has case hardened **steel cone bearings**, arranged in such manner that while they allow a perfectly free revolution of the wheel, there can be no wabbling, rattling or side movement. A coiled spring contained *inside* the harp frame keeps the cones true to the bushings.

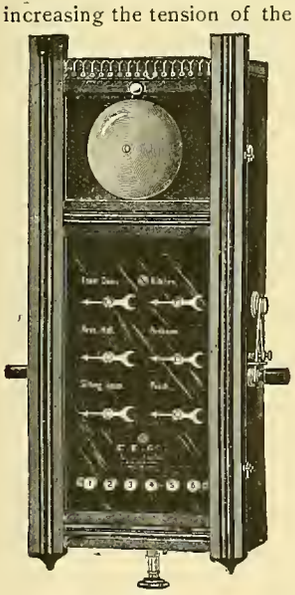
This entire device is made of the best steel. We consider the deep grooved steel wheel much superior to brass or bronze, but will supply them if preferred by customer. The wheel can be detached from harp in one minute for inspection or repairs. **An improved feature** is the "dope" chamber inside the wheel. This will hold sufficient lubricant to last many miles of travel. Thirty cars can be inspected and oiled in ninety minutes. No grease or oil will drip or leak out.

**Let us send you a sample for trial and comparison with any other wheel you have in use.**

## The Chicago Trolley Base



Is substantially built, omitting everything not essential to strength and perfect operation of the parts. THE TROLLEY ARM can be pulled down flat on the car top without increasing the tension of the spring. This relieves it of the catapult feature of all other bases. The castings are of malleable iron, smooth finish and painted.



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We are making a particularly LOW PRICE on the Detroit Burglar Alarm Annunciator. Don't neglect to send your name for one of the special lists mentioned last week.

*Orders and correspondence given prompt attention.*

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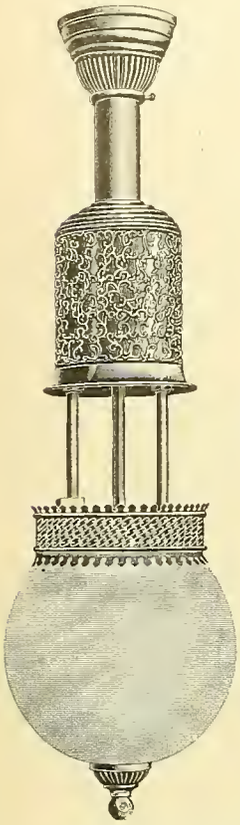
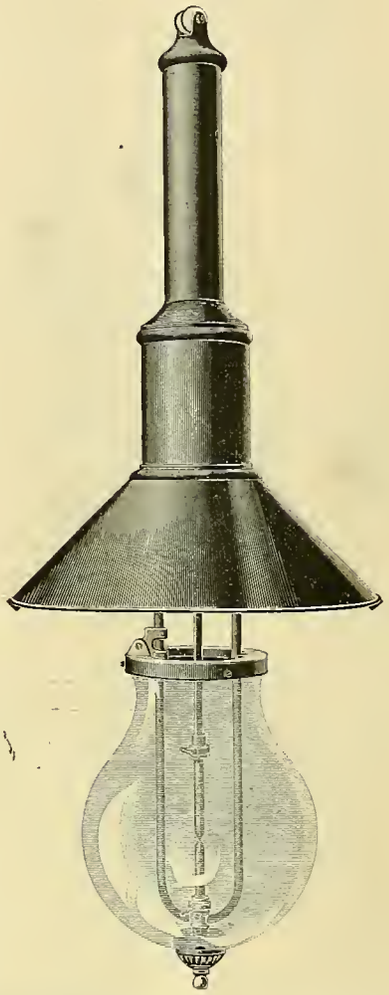


For Direct Current.
For Street Railway Circuits.
For Alternating Circuits.
For Series Arc Circuits.

## NEW AND SUPERIOR.

These lamps are far better than anything manufactured in the line of arc lamps—stronger, simpler, more durable and easier to maintain. They are ALL weatherproof. A trial will convince you of their merits.



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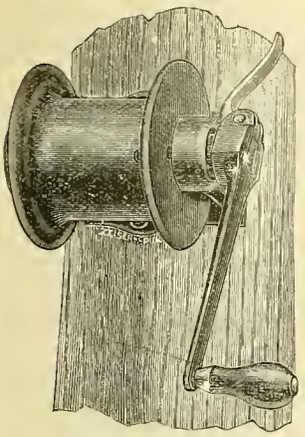

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Before buying it will well repay your time to investigate the Eddy Windlass. We challenge the world for its equal. A mechanical perfection. No complicated parts. Made of practically three castings. Will last a lifetime. Remember that it cannot be left unlocked, and that the crank is the only key that will unlock it. Cannot be tampered with. It is sleet-proof. Always ready to operate quickly. Send for descriptive circular.

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*25 to 5,000 Lights,*
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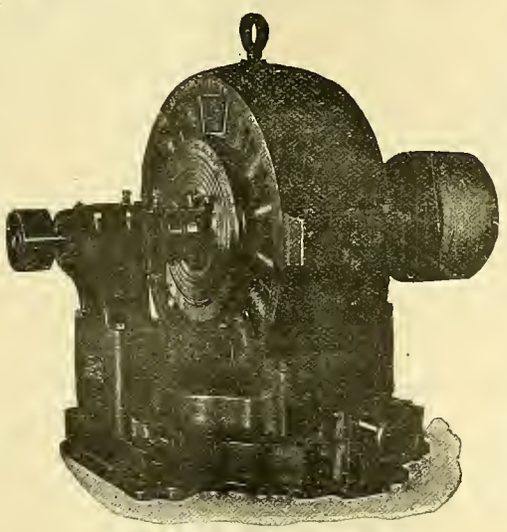

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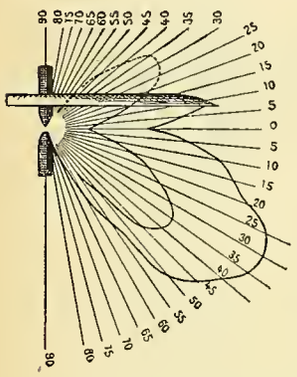

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We claim better distribution of light than any other alternating lamp in the market. We accomplish this by means of **OUR REFLECTOR PLATE.**

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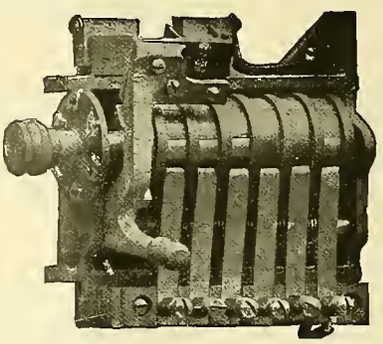

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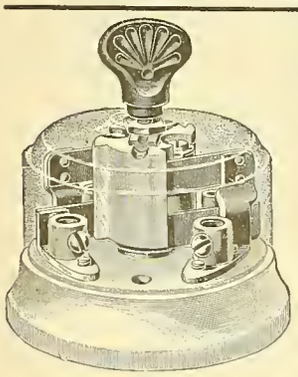

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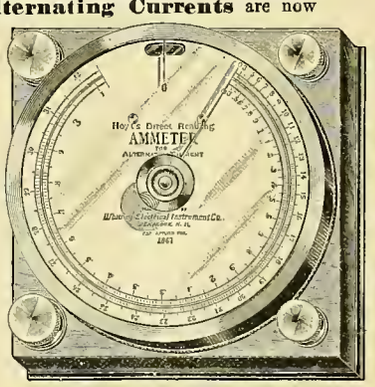


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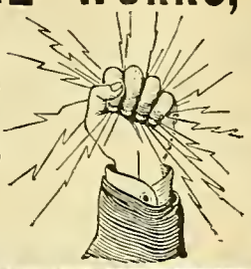

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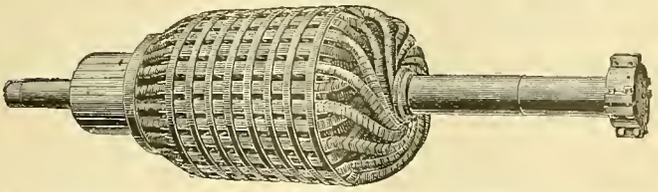

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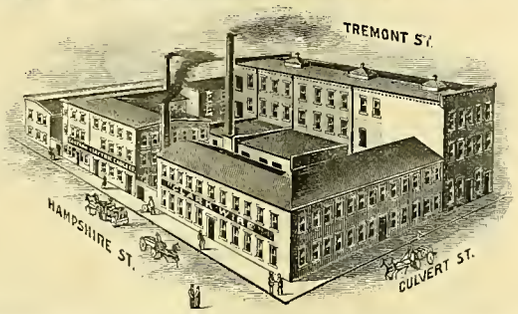


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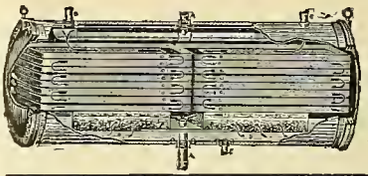

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All built by the National Electric Mfg. Co.
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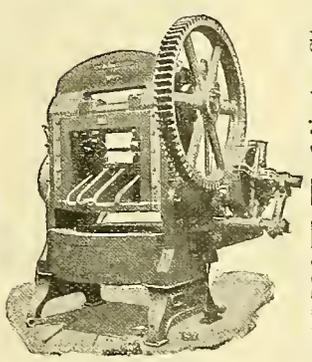
BROOKLYN, N.Y.

GENUINE HARD PORCELAIN, CUT-OUTS, SWITCH BASES, INSULATORS &c

## E. W. BLISS CO.,

14 John St., BROOKLYN, N. Y.



Chicago Office. 100-104 W. Washington St.

This Press is Designed for

**Cutting Armature Discs,**

**Punches, Shears, Drop Hammers, Dies, Etc., For Electrical Work.**

**The Stiles & Parker Press Co.**

## ASSIGNEE'S SALE

OF THE

**Ansonia Electric Company Accounts.**

Notice is hereby given that the undersigned assignee will receive bids in writing:

1. For all the bills and accounts receivable owing to the Ansonia Electric Company, insolvent, at the time of assignment and now unpaid, contracted in Chicago or with the Chicago office or branch of said insolvent.

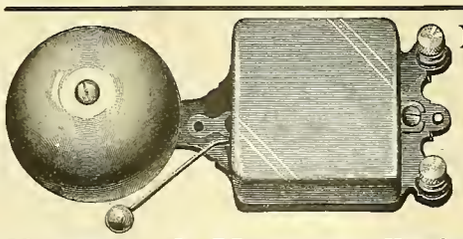
2. All bills and accounts receivable contracted with the undersigned assignee and now unpaid

3. All the balance of the personal property (excepting books of account) belonging to the estate of the insolvent and in the possession of said assignee.

Bids will be received until 12 o'clock noon, September 27, A. D. 1894, at the office of the undersigned, 1514 Ashland Block, Chicago, Illinois. List of the accounts may be found and examined at the above address or will be sent on application. Sale to be approved by the County Court of Cook County.

**JAMES B. WALLER,**
Assignee.

Dated Chicago, September 17, 1894.

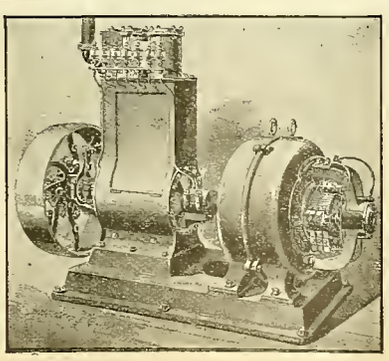


## BELLS,

BRONZE PUSH BUTTONS,
WINDOW AND DOOR SPRINGS,
FLOOR PUSHES,
SWITCHES.

Send for New Catalogue.

**HUEBEL & MANCER,** Manufacturers, 286-290 Graham Street, BROOKLYN, N. Y.



## LUNDELL DYNAMOS AND MOTORS.

**Direct Current, Slow Speed, Iron Clad,**

In Sizes up to 30 Kilowatts.

Lundell Dynamos directly connected to any type of high speed engines.

For Lundell Dynamo and Motor catalogues, prices, etc., address the

**Interior Conduit & Insulation Co.**
44 Broad St., N. Y.


DEPARTMENT OF THE INTERIOR,
WASHINGTON, D. C., August 25, 1894.

Sealed proposals (in duplicate) will be received at the Department of the Interior until 3 o'clock p. m. Monday, September 24, 1894, for the construction of a Telephone Exchange System for the Department of the Interior and at the same time and place proposals will also be received for the extension and modification of the present Telephone System of the Interior Department. Bids must be made on Government blanks. Blank forms of proposal, specifications, etc., may be obtained on application at the office of the Chief Clerk of the Department, where drawings showing details may also be inspected. All proposals received will be opened at the time and place above stated, and bidders are invited to be present at such opening.

JNO. M REYNOLDS, Acting Secretary.


## PLANS and SPECIFICATIONS

For a water works and electric plant will be on file in the Mayor's office on and after September 26, 1894. Parties desiring to bid on the plant may secure a copy of the same on request.

**W. H. Runkle,** Mayor,
Lisbon, Iowa.

## SEALED PROPOSALS

Will be received by the City of Jackson, Tenn., until 12 o'clock noon, October 2, 1894, for furnishing, operating and maintaining forty double arc 2,000 candle power electric lamps on the streets of said city, with the privilege of 50 at the same price per light, for a term of five years. An exclusive franchise will also be granted for all arc and incandescent lighting for both commercial and domestic use for a term of five years. For specifications, etc., apply to

SAM C. LANCASTER,
City Engineer.

## ASSIGNEE'S SALE

OF THE

**Southern Engineering Co.'s Business,**

Consisting of lease on a very desirably located and well fitted electrical supply house, with well assorted and complete stock of electrical supply goods. Also electrical repair and jobbing shop, well equipped with new and modern machinery and good repair and jobbing trade already established. City of 200,000 inhabitants and only one competitor.

An enterprising man with a few thousand dollars can make a profitable investment.

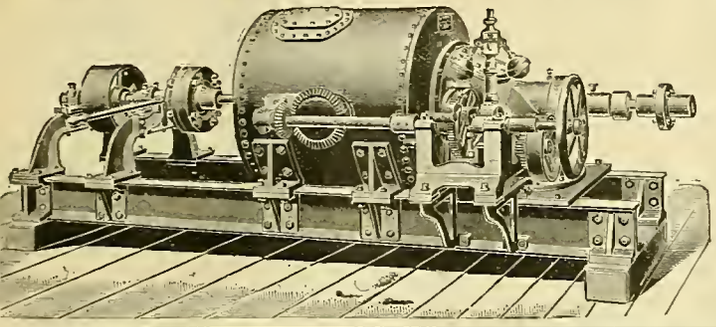
Bids will be received on the whole, or for stock and machinery separately, until 20th day of September, 1894.

**Fidelity Trust & Safety Vault Co., Assignee,**
SOUTHERN ENGINEERING CO.,
206 to 210 Fifth Street, - LOUISVILLE, KY.

## NORTH STAR POINTS

Is the title of a book of reference for all points between Chicago and Lake Superior on the line of the Milwaukee & Northern R. R., and is a valuable publication for business men and tourists who may be interested in the development of the agricultural, mineral and timber resources of Northern Wisconsin and the Upper Peninsula of Michigan. This book, together with an illustrated pamphlet telling "*Where the Trout Hide*" will be sent free upon application to Geo. H. Heafford, General Passenger Agent, "North Star Route," Chicago, Ill.

# VICTOR TURBINE WATER WHEEL.



Cylinder or Register Gate—Close Regulation and High Efficiency at Full and Partial Gate.

The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter**, being **double** the **power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

***SEND FOR CATALOGUE AND PARTICULARS.***

The accompanying engraving represents a single 10-inch Victor Turbine on horizontal shaft to develop 36 H. P. under 38 feet head. Arranged with 12-inch Worrell Friction Coupling at one end to disconnect pulley.

We are now prepared to furnish Victor Turbines, either single or in pairs, on horizontal shafts, and where the situation admits of their use we recommend them.

**The Stilwell-Bierce & Smith-Vaile Co., Dayton, O.**

## TO TELEPHONE COMPANIES:

Kindly bear in mind that the cell which gives an ample and uniform current from first to last, causes the fewest interruptions, and requires the fewest renewals in a given time, is, beyond doubt, the best for telephone work; and that such is the Law Double Cylinder Cell.

## TO BELL-HANGERS:

Do not overlook the fact that if you do good work you will acquire a reputation that will eventually bring you in more money than if the contrary were the case, and in order to do good work that the Law Double Cylinder Cell is the cell for you to use.

## TO RAILROAD ELECTRICIANS:

We would suggest that, inasmuch as the Law Double Cylinder Cell is acquiring an envious reputation amongst railroad men for its efficiency and durability, it would be well worth your while to give it at least a trial.

Various other Law Cells, Zincs, Sal Ammoniac, Carbons, etc.

N. B.—We own the patents covering the Double Cylinder Cell and are the only ones having the right to manufacture it.

**LAW BATTERY COMPANY, 85 John Street, New York.**

## D'UNGER TELEPHONE.

Beware of Infringing or using Infringing Instruments.

**The Only Self-Cleaner.—The Peer of All.**

The D'Unger Telephone (its reputation as the best instrument ever constructed now fully established) is the *only* instrument in which the *power of the voice* is increased; the *only* instrument in which *the electric current is intensified* by the action of the voice; the *only* instrument in which *the voice-wave is reduced*. No telephone can be built with these wonderful advantages *without the use of a lever*. The D'Unger Long-Distance Telephone Company has *the sole and exclusive right to use a lever in telephones—remember that.*

These instruments are supplied to exchanges and toll lines on a small annual royalty. They cannot be had on any other terms.

*The D'Unger Long-Distance Telephone Company owns the first and only undisputed patent for an All-Carbon Multiple-Contact Telephone in this country.* All persons who assert that this company's patents infringe upon any other patents are guilty of premeditated falsehood.

Address all letters to **R. D'Unger,** Manager, Palmer House, Chicago, Ill.

## THREE HOME SEEKERS' EXCURSIONS

To all parts of the West and Northwest via the Chicago, Milwaukee & St. Paul Railway at practically half rates. Round trip tickets, good for return passage within twenty days from date of sale, will be sold on September 11 and 25 and October 9, 1894.

For further information apply at Ticket Office, 207 Clark Street, Chicago.

## GRAPHITE SPECIALTIES

**FOR ELECTRICAL USES:**

**Graphite Rods of Various Lengths, from 1-5 Ohm to 100 Ohms Resistance to the Inch. Graphite Boxes and Crucibles, Resisting Heats of 4,000 Degrees. Inquiries Gladly Answered.**

**JOS. DIXON CRUCIBLE CO., Jersey City, N. J.**

## The "New Era" ELECTRIC GAS LIGHTERS.

**Newly Improved.**

**Are the only Electric Lighters made that are successfully operated by the key,**

Which always indicates whether the gas is on or off. Safe, reliable; will not fail to light; have interchangeable stems; are adaptable to any fixtures, and fully guaranteed. Made in 5 styles but all on the same general principle as style shown. Candle, Billiard, Argand. Our **Victor** with side lever, is a little wonder.

AMERICAN ELECTRIC CO.,
Sole Manufacturers,
**102 Pearl St, Boston, Mass.**
Send for Circulars.

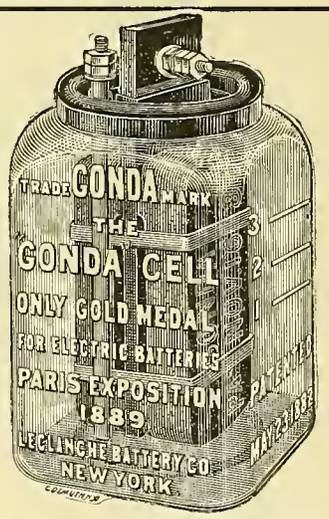
## Lakeview, Washington.

A model manufacturing location. Special inducements offered to manufacturers. Unexcelled facilities for coal and lumber, and shipment by rail and water. Eighty ton iron and steel rolling mill (only one in the state) now being built. Address

THE SOUTH TACOMA COMPANY,
P. O. Box 207, Tacoma, Washington.

**Sleepers Between Chicago and Milwaukee.**

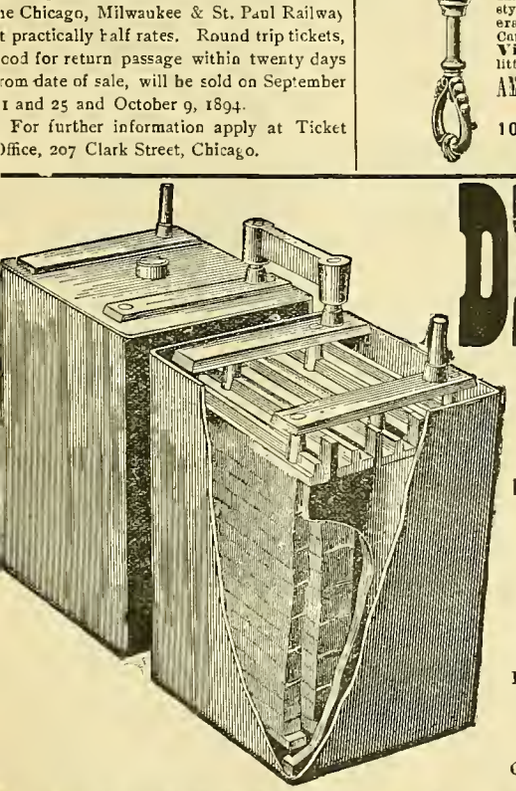
The Chicago, Milwaukee & St. Paul Railway is now running sleeping cars with drawing rooms on night trains between Chicago and Milwaukee. Sleepers can be taken in Union Passenger Station any time between 9:30 and midnight, train leaving Chicago at 3:00 a. m., arriving at Milwaukee at 5:15 a. m., passengers remaining in sleeper until 7:30 a. m. Similar arrangements Milwaukee to Chicago. Berth rate $1.50. For further particulars, for tickets and berths, apply at City Ticket Office, 207 Clark St (Telephone Main 2190), or at Ticket Office, Union Passenger Station.




***The Standard Open Circuit Batteries of the World.***

SEND FOR CIRCULAR AND PRICES.

**THE LECLANCHE BATTERY CO.,**
*111 to 117 East 131st St., N. Y.*



# DECISION IN OUR FAVOR

By all who have used

## STANDARD PLANTÉ BATTERIES.

Will not **Sulphate** nor **Disintegrate,** and cannot **Buckle.**

**HIGHEST EFFICIENCY,**
**LARGEST DELIVERY,**
**LEAST INTERNAL RESISTANCE.**

**Cells from 10 to 10,000 Ampere-Hour Capacity.**

## CENTRAL STATION INSTALLATIONS.

Batteries for **Electric Launches,** for **Dental, Surgical** and **Medical Work,** and for all purposes for which electricity is required.

## BATTERIES FOR TRACTION USE.

Complete Lighting and Power Plants installed as reasonably as consistent with first-class material and workmanship.

**ELECTRIC-POWER STORAGE COMPANY, Room 1210, Havemeyer Building, 26 Cortlandt Street, NEW YORK.**

"NATIONAL" COMPOUND RECEIVER.

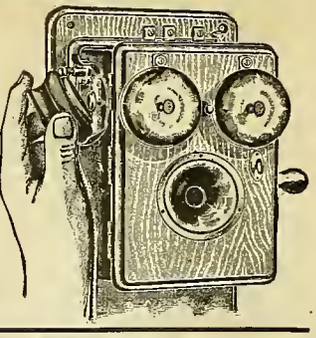
# THE "NATIONAL."

We make simply a business proposition. Buy two sets of our instruments and make your own tests. If satisfactory the way is open for more business, either in telephones or switchboards for exchanges.

**Our head telephones are largely used by Bell telephone operators.**

## NATIONAL TELEPHONE MFG. CO.,

620 (W) Atlantic Avenue, Boston, Mass.



"NATIONAL." Method of Placing Receiver in Holder.

---

THE

# ELKHART TRANSFORMERS,

## HORNBERGER ELECTRIC MFG. CO.,

**ELKHART, INDIANA.**

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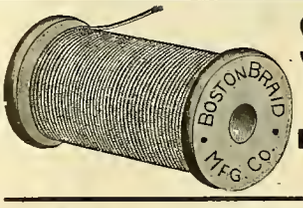


# SILK BRAID

For Incandescent Lamp Filaments.

The greatest care taken in producing a uniform article.

**BOSTON BRAID MFG. CO.,**

27 Beach Street, Boston, Mass.

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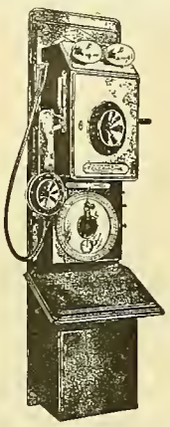
STEPHEN B. ELKINS, Prest. PATRICK EGAN, Sec'y. H. J. HANFORD, Gen'l Mgr.

# The Harrison International Telephone Co.



AGENTS' TERRITORIES NOW BEING ALLOTTED.

WRITE AT ONCE.

**WHAT MONEY CAN EARN AND THE PEOPLE SAVE BY MEANS OF THE**

## Harrison International Telephone.

**We either sell our telephones outright or lease them for a term of years.**

This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Patent No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete electric speaking telephone operated by battery; and owns Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

Prospectuses furnished by addressing the Company at their offices,

Offices, Chamber of Commerce Bldg., Chicago.

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# SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

**ANNUNCIATORS AND BELLS.**

**Full Line Always in Stock.**

**W. R. OSTRANDER & CO.,**

**204 Fulton St., New York.**

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞Send for NEW CATALOGUE. Out August 1st.

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# TELEPHONES!!

This company is manufacturing

## A Compound Magneto Telephone

which it sells outright under a guarantee both as to efficiency and as against infringement of patents.

It talks as well over one hundred miles as any other Telephone talks over one mile.

This company is also prepared to fully equip Telephone exchanges, (furnishing everything from the telephone to the wire and pole). Private lines, Factory plants, etc., and do all kinds of construction work.

Send for circulars and price lists.

## WESTERN TELEPHONE CONSTRUCTION CO.,

**539, 540 and 541 Monadnock Blk., Chicago, Ill**

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# C-S SPECIALTIES.

## C-S Flush Double Push Switch.

Single Pole—Double Pole—Commutation; 3 Wire, 4 Wire.

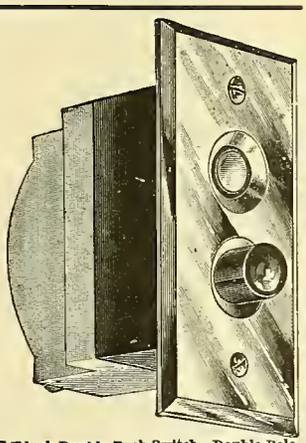
## C-S Flush Key Switch.

Single Pole—Double Pole—3 Wire.

## C-S Flush Automatic Switch.

Single Pole.

ELECTRICALLY MECHANICALLY ARTISTICALLY **PEERLESS.**



C-S Flush Double Push Switch—Double Pole.

## THE CUTTER ELECTRICAL & MFG. CO.,

*27 So. 11th Street, Philadelphia, Pa., U. S. A.*

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# PROTECT YOUR MOTORS

BY USING THE

# HILL PATENT SELF-LOCKING STARTING SWITCH.

**No possible chance for an accident, as the Switch cannot be closed until the resistance is all in.**

**CHEAP. COMPACT. DURABLE.**

MADE ONLY BY THE

## W. S. Hill Electric Co.,

**133 Oliver Street, BOSTON, MASS.**

SEND FOR CIRCULAR AND PRICE LIST.

**NEW YORK, ELSON & BREWSTER, 143 Liberty Street.**

**CHICAGO, CENTRAL ELECTRIC CO.**

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# HUBLEY

## MANUFACTURING COMPANY.

**TROLLEY WHEELS,** Bronze, Brass or Iron, patent graphite bearings, a ***10,000 mile record***—Still running.

**TROLLEY HARPS,** Brass, Bronze, Malleable Iron or Steel. Light, strong, new design. Cheapest and best on the market.

**BEARINGS** For Dynamos and Motors. We guarantee 20 per cent. more life than any anti-friction metal offered for sale.

**Line Ears, Splicing Ears, Curve Pull-Offs, Single and Double Connectors.**

## ELECTRIC LIGHT SUPPLIES.

Switches, Cut-Outs, Regulating Sockets, all of our design and patents. Bare, Weatherproof and Magnet Wire, Arc Light Globes, Pins, Cross Arms, Black and White Tape. Complete equipment for Electric Lighting Plants. Estimates furnished for Electric Railway Installations.

**SAVE MONEY.**

**ASK FOR NEW CATALOGUE.**

## HUBLEY MANUFACTURING CO., Lancaster, Pa.

# BUCKEYE
## INCANDESCENT LAMPS

Monadnock Building, Chicago. **THE BUCKEYE ELECTRIC CO., Cleveland, O.**

**TO FIT ANY STANDARD SOCKET.**

Judge Ricks' decision against the Edison Company and in our favor, frees these lamps from any taint of infringement. Order no other.

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# Artistic Slate

FOR

**Switch Boards, Switch Bases, Rheostat Boxes and Bases, Battery Boxes and Covers, Fuse Boxes and Bases, Lamp Bases,**

And for

**All Purposes Requiring Slate, plain or finished.**

We sell the finest Vermont Slate, and finish in

**Dull Black, Polished Black, Bloodstone or Marbleized, Italian, Tennessee, and Vermont Marble, Mexican Onyx and Grained Woods.**

Very low prices quoted on sizes to order.

**The Independent Electric Co.,**
39th St. and Stewart Ave., CHICAGO.

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General or local **Agents. $75** a week. Exclusive territory. **The Rapid Dish Washer.** Washes all the dishes for a family in one minute. Washes, rinses and dries them without wetting the hands. You push the button, the machine does the rest. Bright, polished dishes, and cheerful wives. No scalded fingers, no soiled hands or clothing. No broken dishes, no muss. Cheap, durable, warranted. Circular free.

**W. P. HARRISON & CO., Clerk No. 12, Columbus, O.**

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**MAP OF THE UNITED STATES.**

A large, handsome Map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of twelve cents in postage by P. S. Eustis, Gen'l Pass. Agent, C. B. & Q. R. R., Chicago, Ill.

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# Knife Switches,

**25 TO 1500 AMPERES.**

SINGLE POLE,
DOUBLE POLE,
TRIPLE POLE,
S. P. FUSE CONNECTION,
D. P. FUSE CONNECTION,
3 P. FUSE CONNECTION,
TABLET BOARDS,

S. P. DOUBLE THROW,
D. P. DOUBLE THROW,
3 P. DOUBLE THROW,
S. P. D. T FUSE CONNECTION,
D. P. D. T. FUSE CONNECTION,
3 P. D. T. FUSE CONNECTION,
SWITCHBOARDS.

Others Can't Compete. —— Prices are too Low.

**A. R. JENNINGS,** 317 Mermod & Jaccard Bldg., **ST. LOUIS, MO.**

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**FUSE WIRE AND LINKS FOR ALL SYSTEMS.** } Correct Carrying Capacity. Absolutely Uniform.

WRITE Us.

ALL SIZES IN STOCK.

**The Independent Electric Co.,**
39th St. and Stewart Ave., Chicago.

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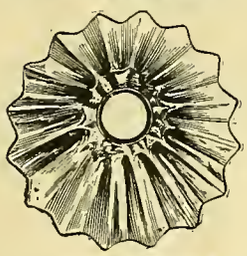
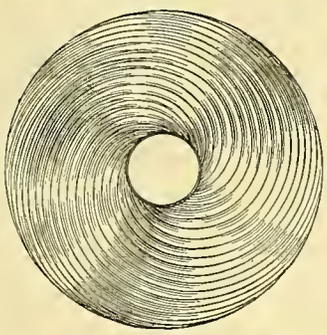
THEY ARE IN STOCK. SEND US A SAMPLE ORDER.



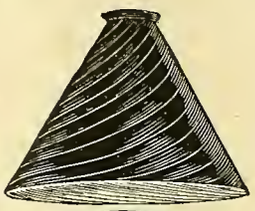
**Radial Fluted.**

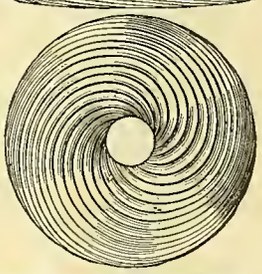
| | | | PER DOZEN |
|---|---|---|---|
| 17 in. diameter, | 2¼ in. | holder, | $ 9.00 |
| 8 " " | 2¼ " | " | 10.00 |
| 0 " " | 2¼ " | " | 12.00 |



**Flat Spiral Corrugated.**

| | | | PER DOZEN |
|---|---|---|---|
| 8 in. diameter, | 2¼ in. | holder, | $ 8.00 |
| 10 " " | 2¼ " | " | 9.00 |





**Deep Spiral Corrugated.**

| | | | PER DOZEN |
|---|---|---|---|
| 7 in. diameter, | 2¼ in. | holder, | $ 8.00 |
| 10 " " | 2¼ " | " | 12.00 |

# GLEASON'S STANDARD ELECTRIC SILVER GLASS REFLECTORS.

Enameled Green Outside, Silvered Inside.

The simplest, cheapest and best Reflectors for increasing candle power of incandescent lamps.
Made in all staple sizes of electric shades.
Always bright; cannot tarnish.

**E. P. GLEASON MFG. CO.,** 181 to 189 MERCER STREET, NEW YORK.

**CHICAGO OFFICE,**
**91 Dearborn Street,** F. L. JOHNSON, Manager.

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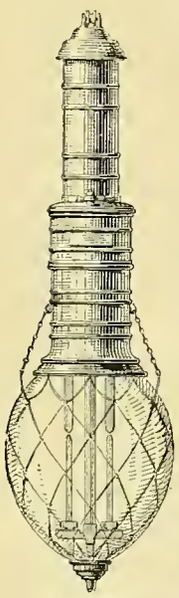


No. 2607
"Twin" Lamp.

# The New "Bergmann" Arc Lamps

**For Constant Potential Circuits.**

## BETTER than all others BECAUSE

THEY HAVE

**No Adjusting Springs and No Escapements**

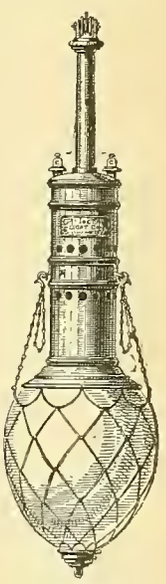
AND CONSEQUENTLY CAN

**Not Get Out of Adjustment or Flicker or Stick.**

**Send for Descriptive Circular of Direct and Alternating Current Lamps, Blade Switches, Imported Carbons, Etc. Prices greatly reduced on everything.**

**THE LATEST IS OUR NEW "TWIN" LAMP.**

## GENERAL INCANDESCENT ARC LIGHT CO.,
**NEW YORK.**



No. 2425
A. C. Lamp.

169 Adams Street, CHICAGO. S. BERGMANN, President. 572 to 578 First Ave., NEW YORK.

# YOU NEED THESE BOOKS.

NEW
## DYNAMO TENDERS' HAND-BOOK.
By Lieut. F. B. Badt.

READY FOR DELIVERY.
AN ENTIRELY NEW WORK.

The latest addition to our famous "Hand-Book" Series. Every practical dynamo man should have a copy.

*226 Pages. 138 Engravings.*

**PRICE, $1.00.**

## INCANDESCENT WIRING HAND-BOOK.
By Lieut. F. B. Badt.

Fourth Edition. Tenth Thousand.

These tables give, without loss of time, exact size of wire to be used. This is one of our famous "Hand-Book" series, and is the standard authority on this subject in the English language.

72 Pages. 42 Illustrations.

**PRICE, $1.00.**

## BELL HANGERS' HAND-BOOK.
By Lieut. F. B. Badt.

Designed for practical men engaged in any class of bell or annunciator work. The only book of the kind published.

106 Pages. 97 Illustrations.

**PRICE, $1.00.**

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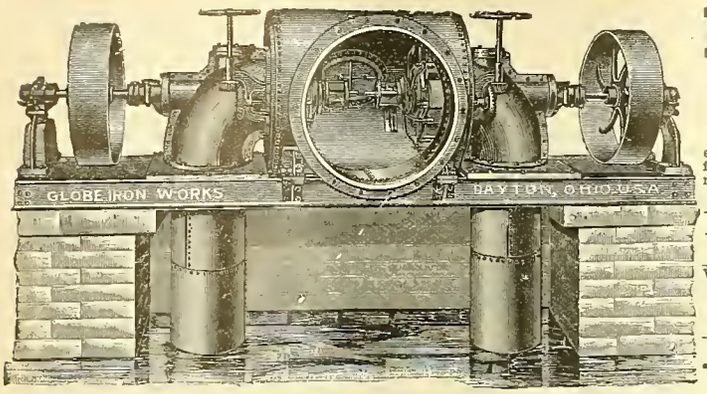


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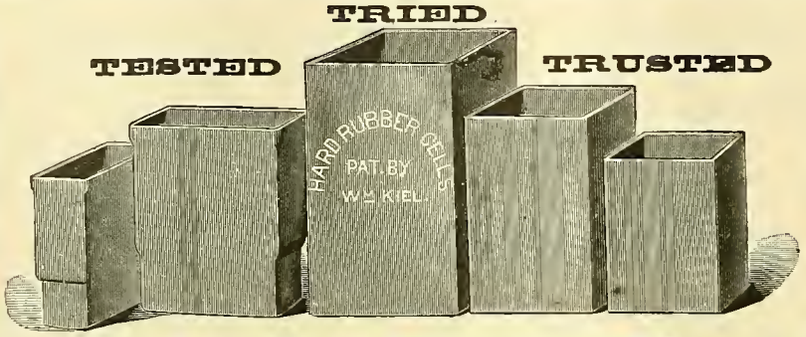


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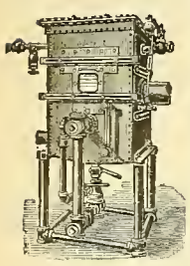

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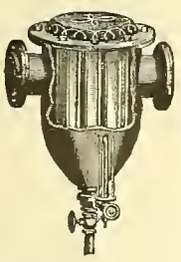

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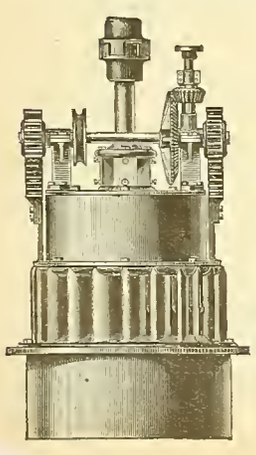

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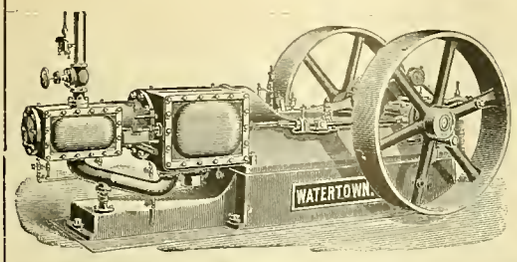


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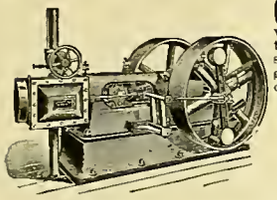

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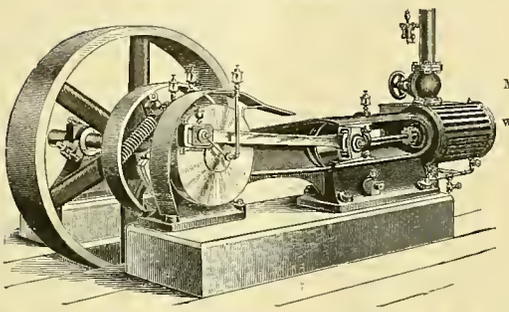

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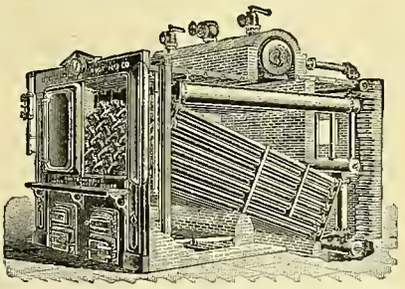

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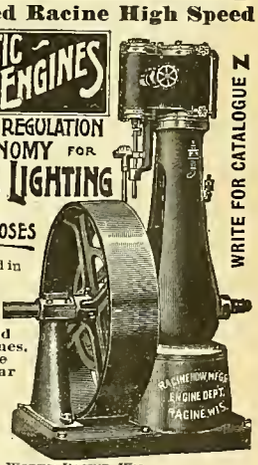

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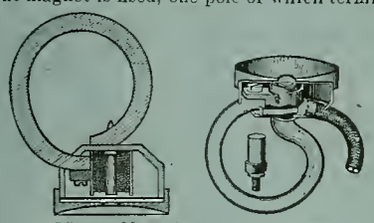

FIGS. 27 AND 28. D'ARSONVAL RECEIVER.

in a soft iron polepiece that serves as the core of the coil, and the other in an iron box, or cylinder, that

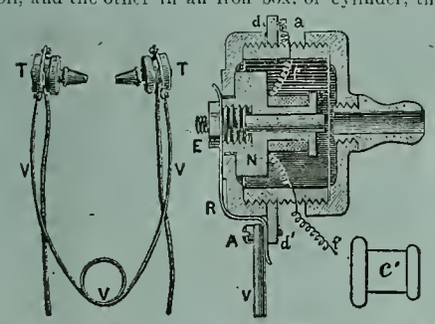


FIG. 29. MERCADIER'S BI-TELEPHONE. *T T* RECEIVERS, *V* SPRING, *N* MAGNET, *E* NUT, *R* STEEL STRIP, *A* SCREW CLAMPING *R* TO *V*, *d d'* METAL COLLAR CLAMPING *V* TO RECEIVER CASE, *f f* TERMINALS OF COIL *a* CONNECTING SCREW, *c'* SOFT RUBBER NIPPLE FOR EARPIECE.

completely encloses the coil. The two poles are magnetically insulated from each other by the wooden case, to the upper part of which the diaphragm is

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appeared on the scene with an application for a patent on a microphonic transmitter, and according to the rules of the Patent Office no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbaugh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbaugh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad

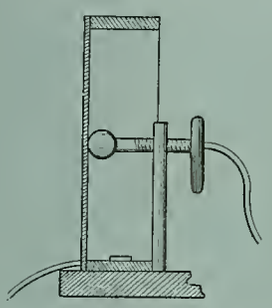

FIG. 44. BERLINER'S FIRST TRANSMITTER.

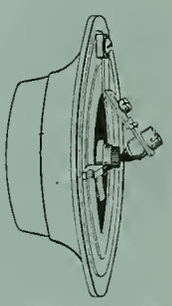

FIG. 45. BERLINER CARBON TRANSMITTER.

principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

78. Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by cans-

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Chapter 1: The Invention of the Telephone.—Chapter 2: Sound Waves. Articulate Speech.—Chapter 3: Electric Telephony. The Bell Telephone.—Chapter 4: The Microphone.—Chapter 5: Current Induction. Electromagnetic Induction.—Chapter 6: The Induction Coil; Its Use in the Telephone Transmitter.—Chapter 7: The Complete Telephone Circuit.—Chapter 8: Magnet Telephones.—Chapter 9: The Bell Telephone Receiver.—Chapter 10: Other Forms of Magnet Telephones.—Chapter 11: The Gower, Ader and D'Arsonval Receivers; Mercadier's Bi-telephone.—Chapter 12: The Siemens, Kotyra, Neumayer and Bottcher Receivers.—Chapter 13: Carbon Transmitters.—Chapter 14: The Blake Transmitter.—Chapter 15: The Long-distance Transmitter.—Chapter 16: The Solid-back Transmitter.—Chapter 17: The Berliner Transmitter.—Chapter 18: The Cuttriss Transmitter.—Chapter 19: Various European Transmitters.—Chapter 20: The Efficiency of Carbon Transmitters.—Chapter 21: Batteries for Telephone Work.—Chapter 22: Open Circuit Batteries.—Chapter 23: Closed Circuit Batteries.—Chapter 24: The Practical Management of Batteries.—Chapter 25: Magneto Bells.—Chapter 26: Automatic Switches.—Chapter 27: Telephone Line Construction.—Chapter 28: Metallic Circuits.—Chapter 29: Underground Wires.—Chapter 30: Lightning Arresters.—Chapter 31: Inside Wiring.—Chapter 32: Installation of Telephone Instruments.—Chapter 33: Inspection and Maintenance.—Chapter 34: The Condenser; Its Use in Telephony.—Chapter 35: Electromagnetic Retardation.—Chapter 36: Exchange Working.—Chapter 37: Small Exchanges.—Chapter 38: Party Lines; The Bridging Bell.—Chapter 39: Long Distance Telephony.—Chapter 40: Duplex Telephony.—Chapter 41: Simultaneous Telegraphy and Telephony.—Appendix.

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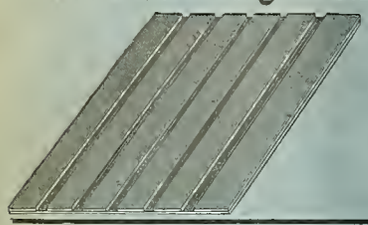

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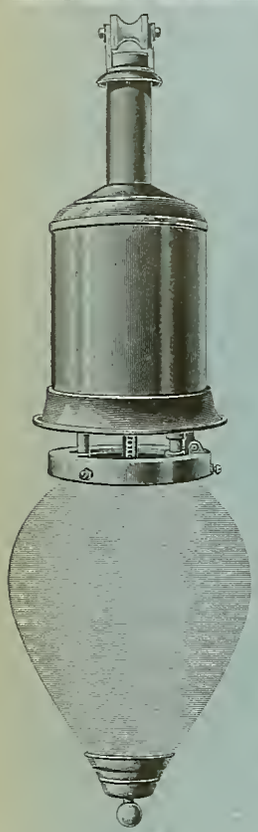

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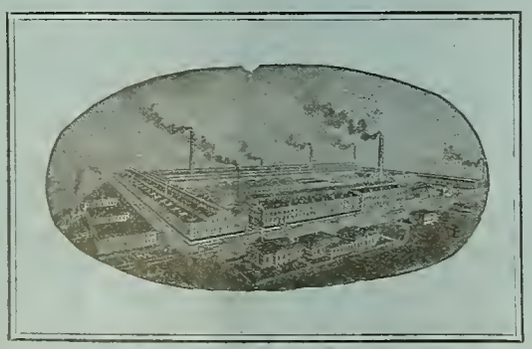

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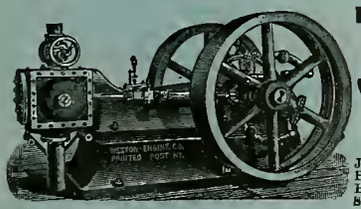

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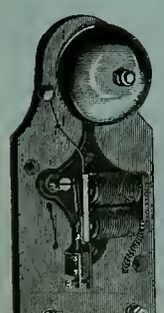

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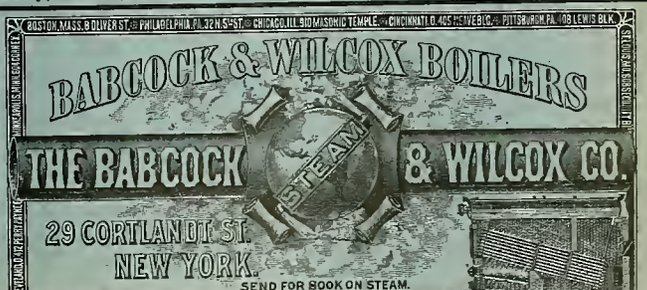


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**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Roberts & Co., E. P.
Rushmore, S. W.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Engravers.**
Illinois Engraving Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Central Electric Co.
Interior Conduit & Ins. Co.
Muncie Elec. Mfg Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Caoot Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Palmer Bros.
Porter & Buerdorf.
Sioux City Brass Works.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Hubley Mfg. Co.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.
Hubley Mfg. Co.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Vulcanized Fibre Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Hubley Mfg. Co.
Independent Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Jennings, A. R.
Matner Electric Co.
Metropolitan Electric Co.
New York & Ohio Co.
United Elec. Imp. Co.
Westinghouse Elec & Mfg. Co.

**Lightning Arresters.**
Central Electric Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Wirt, Chas.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery.**
Bliss Co., E. W.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

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Independent Electric Co.
Westinghouse El. & Mfg. Co.

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Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co.

**Packing.**
Garlock Packing Co.

**Paints.**
Standard Paint Co.

**Phosphor Bronze.**
Phosphor Bronze Sm. Co. Ltd

**Platinum.**
Baker & Co.

**Poles.**
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Morris, Tasker & Co.
Nuttall Co., R. D.

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Empire China Works.
Chicago Gen'l Fixture Co.
General Electric Co.
Phœnix Glass Co.

**Publishers, Electrical.**
Electrician Publishing Co.

**Push Buttons.**
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.

**Rheostats.**
General Electric Co.
Rushmore, S. W.

**Sal Ammoniac**
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Klipstein, A. & Co.
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**Silk Braid.**
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**Slate.**
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Ostrander & Co., W. R.

**Speed Indicators**
Whitney Elec. Instrument Co

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Webster & Co., Warren.

**Steam Pumps.**
Worthington, Henry R.

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Cons. Electric Storage Co.
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Electric Storage Battery Co.
Hascke & Creelman.
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Consolidated Car-Heating Co.

**Street Cars.**
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American Electrical Works.
Central Electric Co.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

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Electric Appliance Co.
Metropolitan Electric Co.
Western Electric Co.

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D'Unger Loug Dist. Tel. Co
Harrison Int. Telephone Co.
Imperial Telephone Wks.
Metropolitan Electric Co.
National Telep. Mfg. Co.
Palmer Bros.
Western Electric Co.
Western Tel. Const. Co.

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Bradley & Co.

**Transformers.**
General Electric Co.
Hornberger Elec. Mfg. Co.
Ft. Wayne Elec. Corporation
Jennings, A. R.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wallace Electric Co.
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Samson Cordage Wks.

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Smith, S. Morgan.

**Windlasses.**
Whitehead, S. E.

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Bishop Gutta Percha Co.
Central Electric Co.
Electric Appliance Co.
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National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
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# SIMPLEX.

If you want a wire that will wear through a tree without impairing the insulation—
If you want a wire that will stand up under all condi.ions—
If you want a wire that will outlast any other on the market—

Buy SIMPLEX T. Z. R. Weatherproof, it is cheapest in the end.

## SIMPLEX BRAIDED CAOUTCHOUC.

Highest excellence, uniform in quality—the ideal rubber-covered wire for concealed work.
Write for prices. Prompt shipments from Chicago stock. No intermediate profits to be taken into consideration.

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## HABIRSHAW WIRES AND CABLES.
The Highest Grade of Rubber Insulation.

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ARC LAMPS FOR ALL CIRCUITS.
"The Best Lamp on Earth."

## ROBINSON PATENT TROLLEY WHEEL.

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Approved by every Board of Fire Underwriters.

## SHIELD BRAND MOISTUREPROOF WIRE.

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Gives Best Return for Current Used.

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Thoroughly Protects Apparatus.

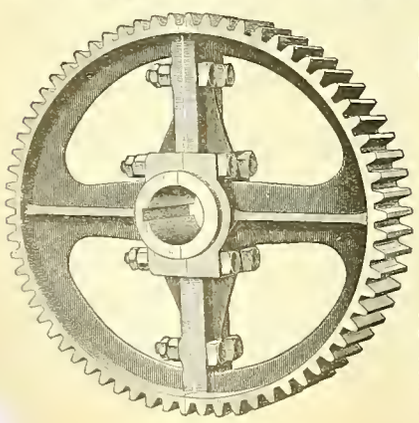
## ELECTRIC LIGHTING MATERIAL.
## ELECTRIC RAILWAY SUPPLIES.
## ELECTRICAL HOUSE GOODS.

Good Goods. Low Prices. Prompt Shipments. Write for What You Want.

## WALLACE ELECTRIC CO., 307 Dearborn Street, CHICAGO.

## R. D. NUTTALL COMPANY, Allegheny, Pa.

F. A. ESTEP, President and Treasurer.
J. R. McGINLEY, Vice-President.
F. S. MARTIN, Superintendent of Works.

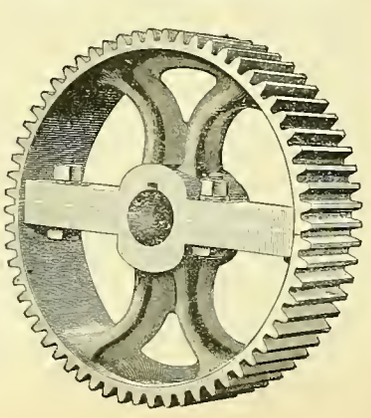


MANUFACTURERS OF
**Electric Railway Supplies.**

**GEARS, PINIONS, BEARINGS, TROLLEYS, TROLLEY WHEELS AND HARPS.**

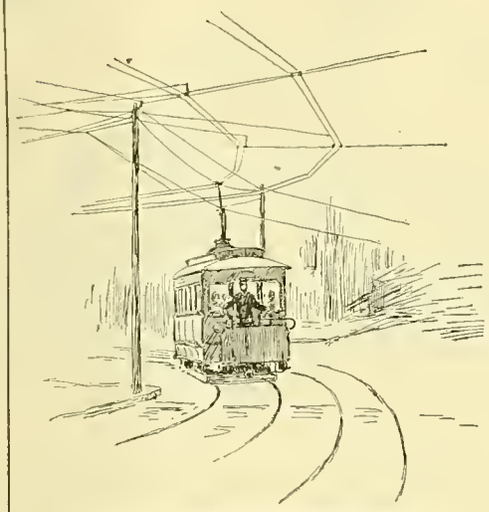
THIS IS THE IMPROVED NUTTALL TROLLEY.

TRY IT ONCE, AND YOU WILL WANT NO OTHER.



**The largest and most prosperous street railway companies in the country are using our supplies, and they prefer them to all others on account of greater strength and durability. Correspondence solicited.**

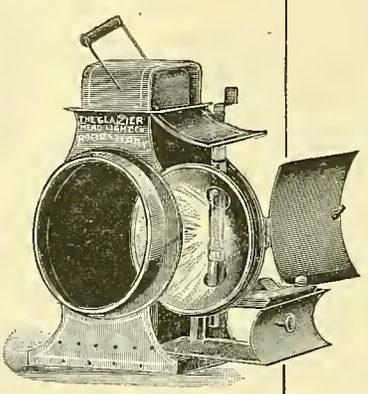
CHAS. J. MAYER, 600 Betz Building, Philadelphia, Pa., Middle States Sales Department.
CHAS. N. WOOD, 180 Summer St., Boston, Mass., New England States Sales Department.
STANDARD R'Y SUPPLY CO., Monadnock Block, Chicago, Ill., N. W. States Sales Department.
A. S. PARTRIDGE, Bank of Commerce Building, St. Louis, Mo., S. W. States Sales Department.
CHAS. A. CAVAONA, Neave Building, Cincinnati, Ohio, Central States Sales Department.



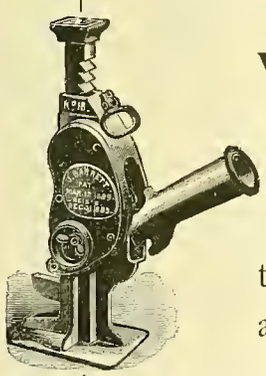
Are we coming to double trolleys?

# In our Railway Department

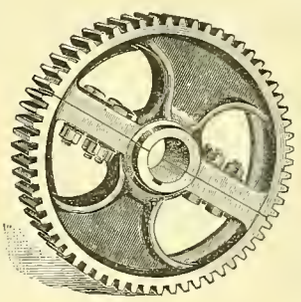
you can find a score of good things that we are willing to guarantee the best in the market. That may read a little old-fashioned, but the goods themselves are blessed with the latest wrinkles that smart inventors have racked out of their teeming brains. The aim has been, and will be, to select those devices which do the work in the simplest manner with the least amount of mechanism.



QUALITY is considered paramount to price, but the prices are utterly devoid of fancy frills and come as near being hard-pan as we know how to figure them and still maintain friendly relations with our landlord.



**We know** that we can satisfy the most finical and exacting buyer; the era of flim-flam in the electrical business has, happily for all concerned, reached a low ebb; the goods that we ship out, from whatever department, must be as we represent them or you get your money back without argument.



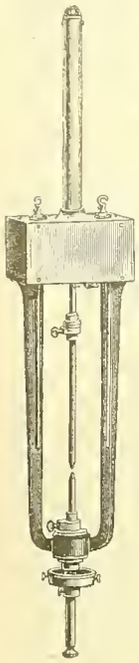
**What we want is orders** and they will be filled exactly as specified and shipped with gratifying promptness.

**HAVE YOU RECEIVED ONE OF OUR HOUSE GOODS SPECIAL LIST?**

BRANCHES:
St. Louis: Southern Electrical Supply Co.
Kansas City: Gate City Electric Co.

GENERAL WESTERN AGENTS
Okonite Wires, Interior Conduit, Lundell Fans, Helios Arc Lamps, Washington Carbons, Carpenter Enamel Rheostats.

**Central Electric Company,**
173-175 Adams Street,
Chicago, Ill.



# STANDARD "WARD" LAMPS

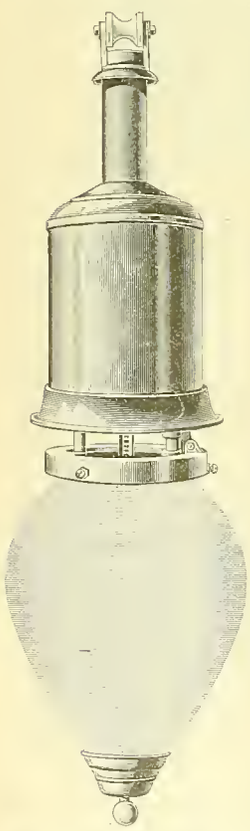
## For Direct Current, 110 Volts,

# TEN DOLLARS EACH

**With Globe and Resistance $2.00 Extra.**

**There are more lamps of the above type in use in the United States on Incandescent Circuits, than all other makes combined.**

# Send in Your Orders Quickly!



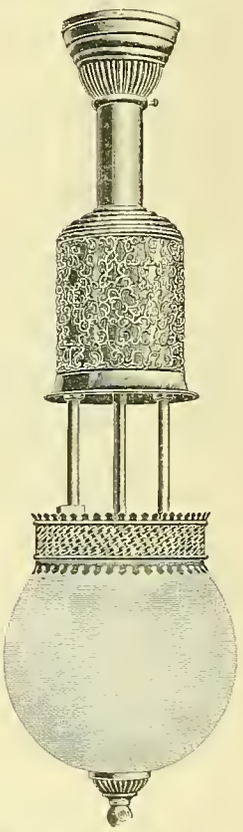
We have a complete line of Lamps for

Alternating Circuits,
Series Arc Circuits,
Direct Current, plain and ornamental
and Street Railway Circuits,
*AT FAIR PRICES.*

**STRONGEST, SIMPLEST,
MOST DURABLE,
EASIEST TO MAINTAIN.**

We manufacture all kinds of Focusing Lamps, Search Lamps, Theatrical Lamps, Stereopticon Lamps and Special Lamps of any description.

If you want ANYTHING in the line of Arc Lamps, write us before purchasing elsewhere.



# ELECTRIC CONSTRUCTION & SUPPLY CO.,

*Established 1881.*

18 CORTLANDT ST., NEW YORK.

**Wallace Electric Co., Agents, 307 Dearborn St., Chicago, Ill.**

Tree Insulator.
Perfect Protect on.

# MOULDED MICA.

TREE INSULATORS, WEATHERPROOF SOCKETS, ETC.,

## TROLLEY LINE INSULATORS

Are the recognized standard for strength, durability and superior insulating qualities.

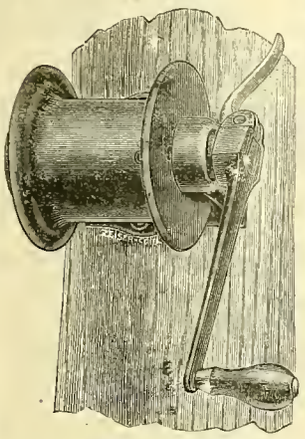
**Hangers, Pull-offs, Bracket Arm Insulators, Strain Insulators, Pole Insulators, Insulated Crossings, Frogs, Rail Bonds, Etc., Etc.**

**VULCABESTON** Heat and Moisture-proof Insulation.

**H. W. JOHNS MFG. CO.,**

New York, Philadelphia, Boston. **240 Randolph Street, CHICAGO.**

# THE EDDY PATENT SELF-LOCKING WINDLASS



WINDLASS UNLOCKED.

For Raising and Lowering Arc Lamps.

Before buying it will well repay your time to investigate the Eddy Windlass. We challenge the world for its equal. A mechanical perfection. No complicated parts. Made of practically three castings. Will last a lifetime. Remember that it cannot be left unlocked, and that the crank is the only key that will unlock it. Cannot be tampered with. It is sleet-proof. Always ready to operate quickly. Send for descriptive circular.

**S. E. WHITEHEAD,**
**General Agent for the U. S.,**
CARTHAGE, MO.

# STREET LIGHTING FROM ALTERNATING CURRENT DYNAMOS.

**New Prices given on** **Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters**

**And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.**

***This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.***

## OUR SERIES LAMPS

***Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.***

## BERNSTEIN ELECTRIC COMPANY, 620 Atlantic Ave., Boston, Mass.

# We Want Western Business.

# LA ROCHE ALTERNATORS.

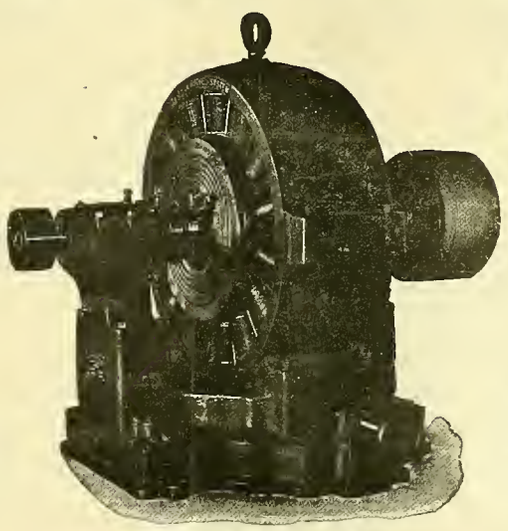
MANUFACTURED IN SIZES FROM

*25 to 5,000 Lights,*

SINGLE OR MULTIPHASE.

Direct Connected Dynamos.

Direct Current Generators.



**1,000 Light Alternator.**

## La Roche Electric WORKS,

PHILADELPHIA, PA.

DISTRICT OFFICES:

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**OWEN FORD, Rialto Building, ST. LOUIS, MO.**

# THE C & C ELECTRIC COMPANY

MANUFACTURERS OF

## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

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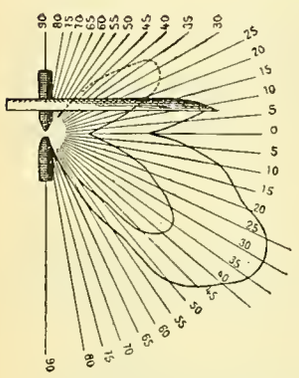
Works: GARWOOD, N. J.
on CENTRAL R. R. of N. J.

BRANCH OFFICES: CHICAGO, 1020 and 1021 Monadnock Building. BOSTON, 63 Oliver St. CLEVELAND, Cuyahoga Building. PHILADELPHIA, 633 Arch St.

# A GREAT REDUCTION
## IN PRICES
ON OUR



# Reflector Plate Alternating ARC LAMPS.

We claim better distribution of light than any other alternating lamp in the market. We accomplish this by means of **OUR REFLECTOR PLATE.**

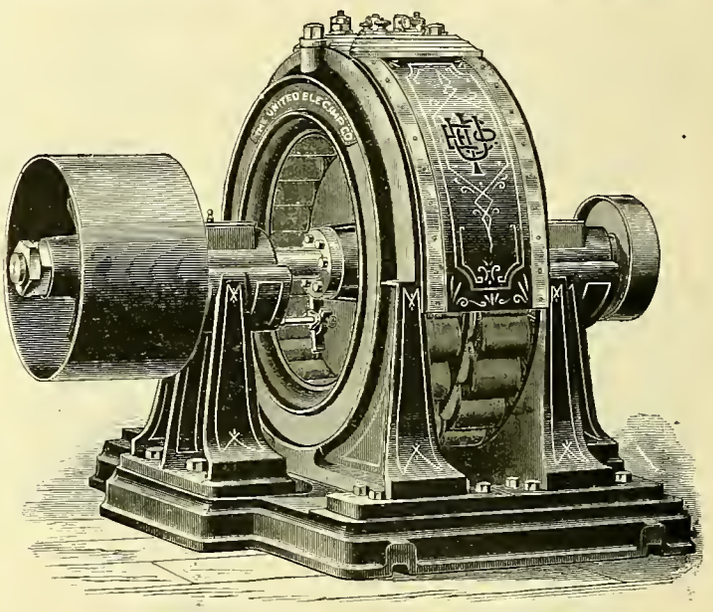
We claim that we can obtain more economy than any other alternating lamp in the market. We do this by means of the **SPENCER ECONOMY COIL.**

We will beat the market for prices on Helios carbons this fall.

# Helios Electric Co.,
1310 Filbert St., PHILADELPHIA, PA.

# Alternating Current Generators,
**For Central Station Equipment.**

Adapted for Arc and Incandescent Lighting.
Guaranteed Equal in Every Respect to any other Type of Apparatus Manufactured.



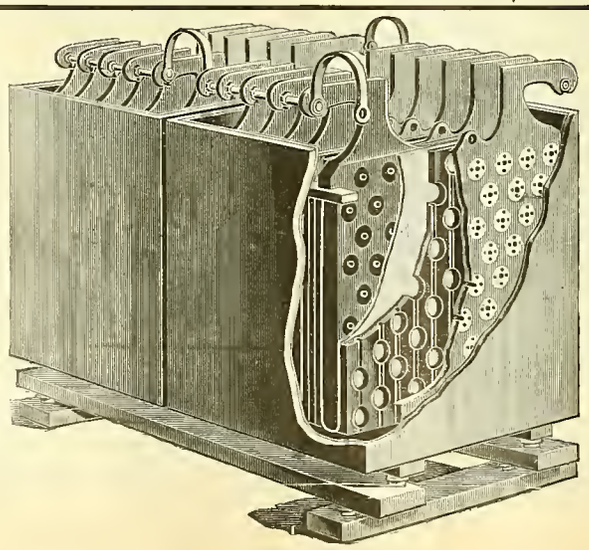
Slow Speed and Close Regulation. Standard of Simplicity and Durability.

**ALSO**

Direct Current Apparatus for Lighting Factories, Public Buildings and Isolated Plants.
Improved Long Distance Series Incandescent Apparatus for Street and Commercial Illumination.
Incandescent Lamps and Sockets for use on Arc Light Circuits.

**Correspondence Solicited.**

## THE UNITED ELECTRIC IMPROVEMENT CO.,
Drexel Building, Philadelphia, Pa.



# THE CHLORIDE ACCUMULATOR.

*Cells from 10 to 5,000 amp. hours Capacity.*

Central Station and Traction Cells a Specialty.

BATTERIES FOR ISOLATED LIGHTING AND POWER PLANTS.

Catalogue gives FACTS and FIGURES.

THE ELECTRIC STORAGE BATTERY CO.,
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JOHN R. MARKLE, Mgr. Western Department,
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# ROYAL ELECTRIC CO., PEORIA, ILL.

MANUFACTURERS OF

## The Most Reliable ALTERNATING System now on the Market.

**OUR ALTERNATOR HAS:**

NO COLLECTING RINGS. NO COMMUTATOR. NO REVOLVING FIELD OR ARMATURE COILS.

**Step Down TRANSFORMERS.** **Step Up TRANSFORMERS.**

TRANSFORMERS for any desired Voltage. Arc Light TRANSFORMERS. Direct Current Generators and Motors.

CORRESPONDENCE SOLICITED.

# Consolidated Car-Heating Co.,

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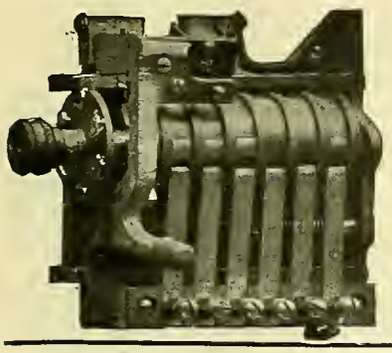

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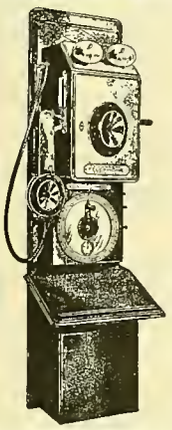

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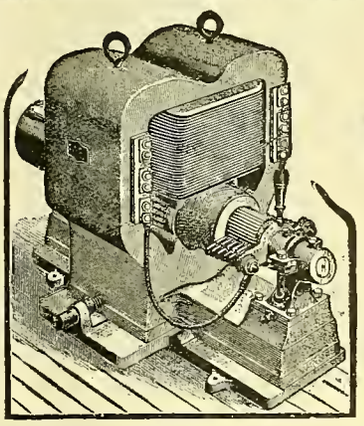

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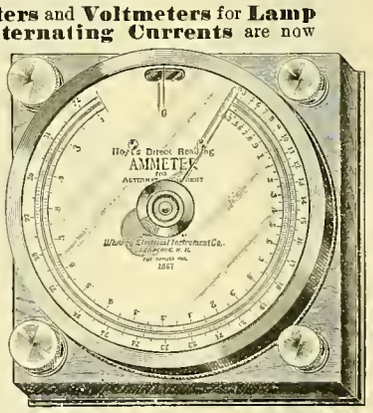


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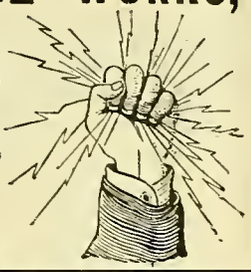

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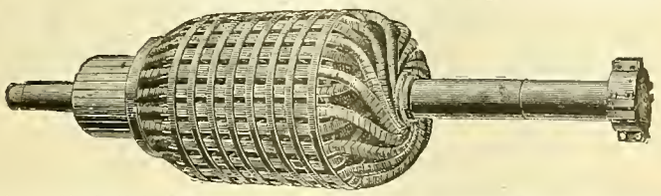

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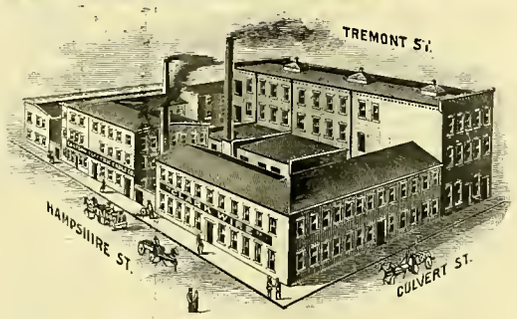


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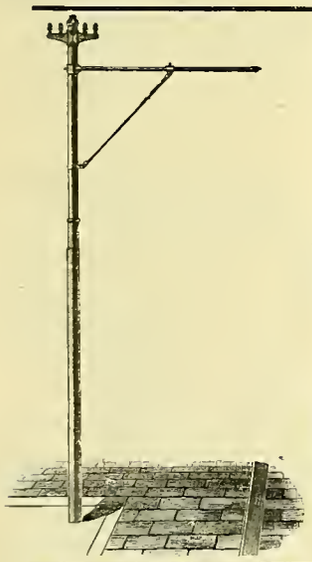

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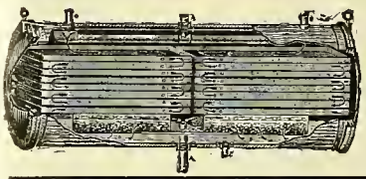

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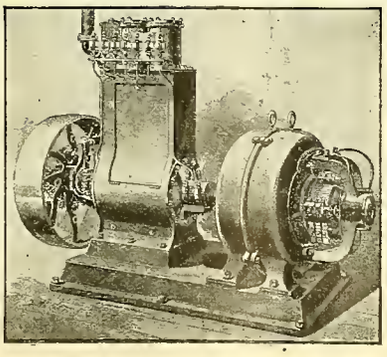

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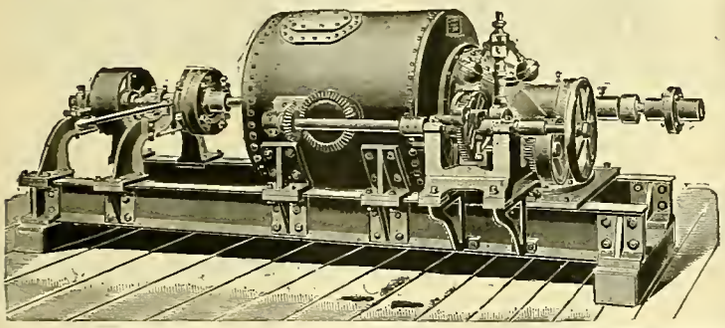

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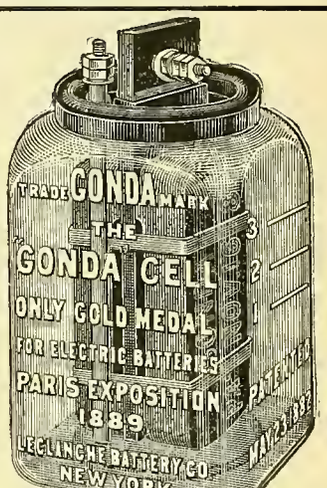


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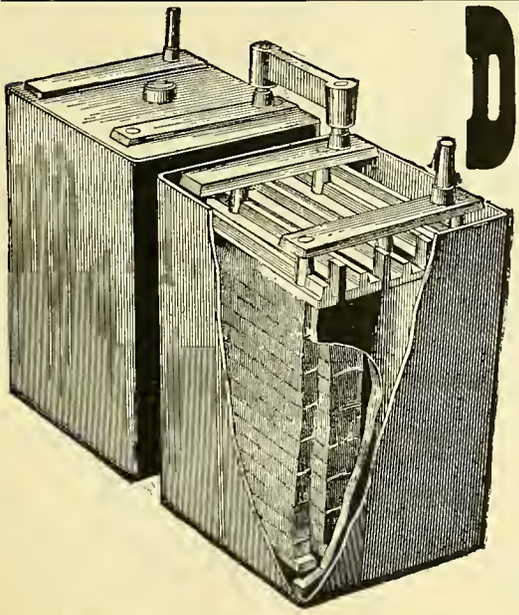

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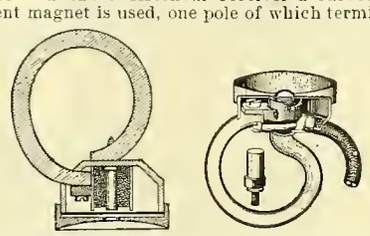
ductor. In the D'Arsonval receiver a curved permanent magnet is used, one pole of which terminates



FIGS. 27 AND 28. D'ARSONVAL RECEIVER.

in a soft iron polepiece that serves as the core of the coil, and the other in an iron box, or cylinder, that

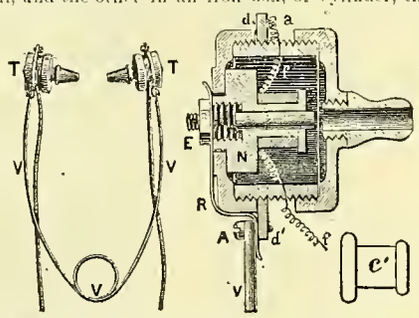



FIG. 29. MERCADIER'S BI-TELEPHONE. *T T* RECEIVERS, *V* SPRING, *N* MAGNET, *E* NUT, *R* STEEL STRIP, *A* SCREW CLAMPING *R* TO *V*, *d d'* METAL COLLAR CLAMPING *V* TO RECEIVER CASE, *f f* TERMINALS OF COIL *a* CONNECTING SCREW, *c'* SOFT RUBBER NIPPLE FOR EARPIECE.

completely encloses the coil. The two poles are magnetically insulated from each other by the wooden case, to the upper part of which the diaphragm is

48 TELEPHONE HAND BOOK.

appeared on the scene with an application for a patent on a microphonic transmitter, and according to the rules of the Patent Office no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbaugh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbaugh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad

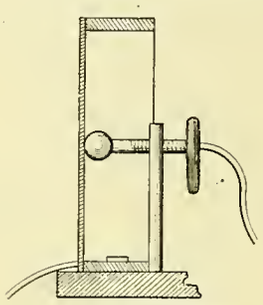


FIG. 44. BERLINER'S FIRST TRANSMITTER.

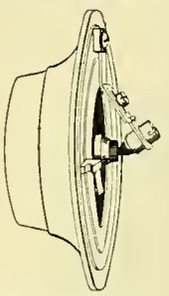


FIG. 45. BERLINER CARBON TRANSMITTER.

principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

78. Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by cans-

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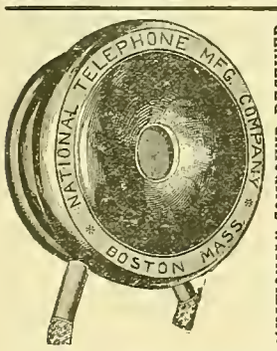


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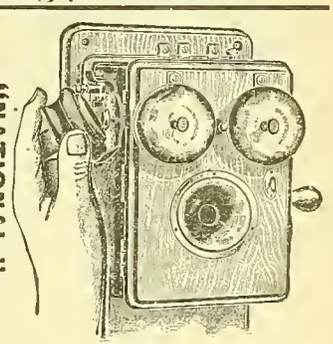

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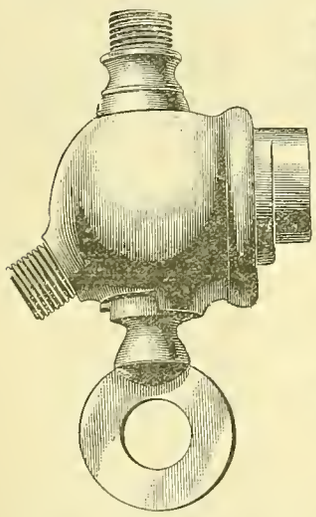

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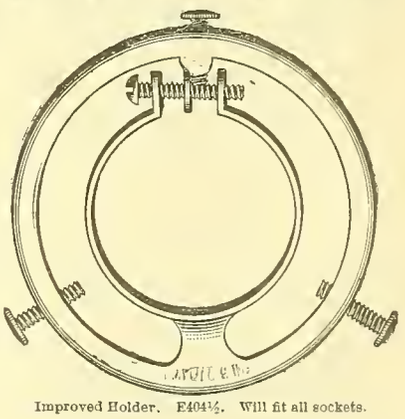

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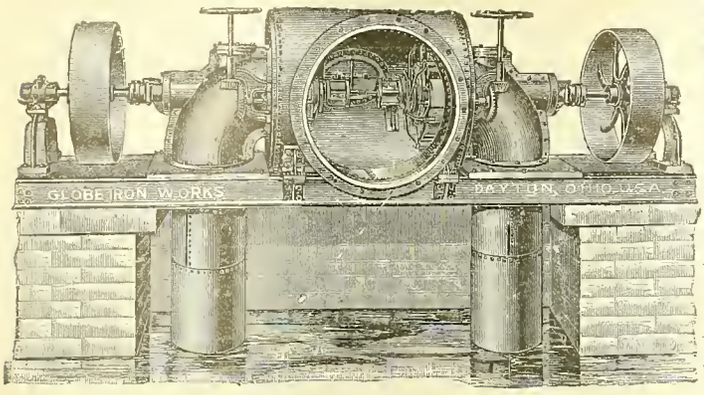


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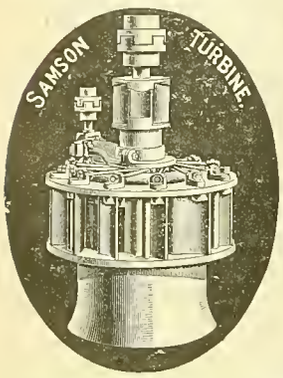


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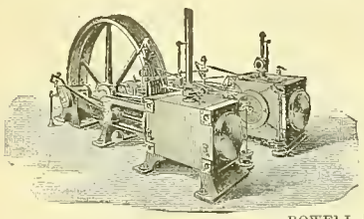

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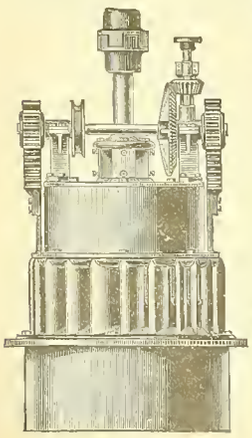

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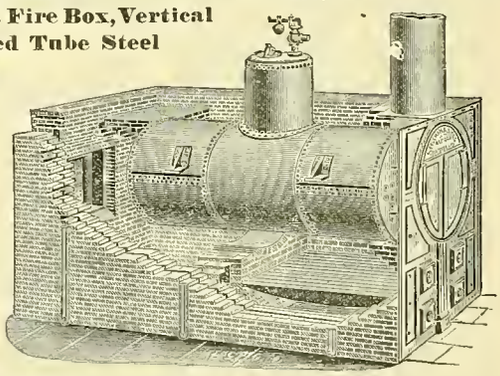

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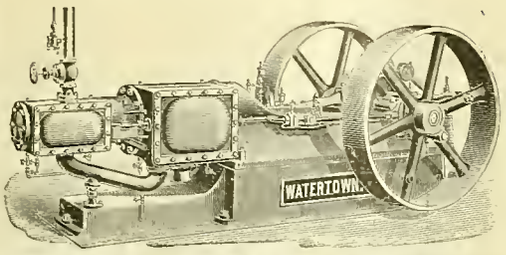

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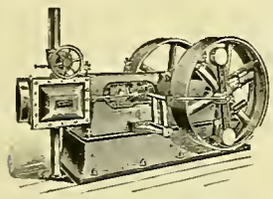

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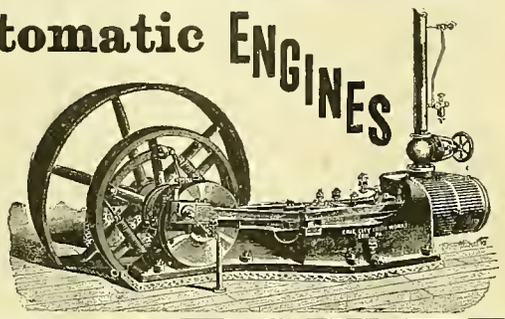

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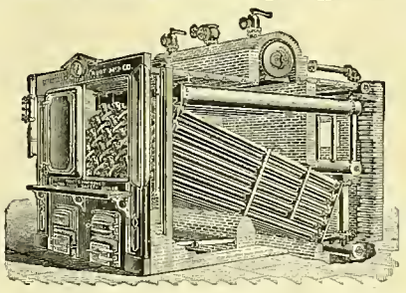

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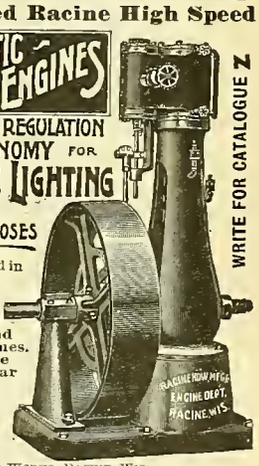

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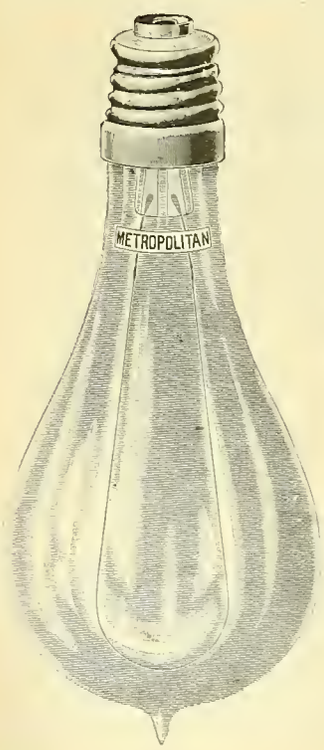


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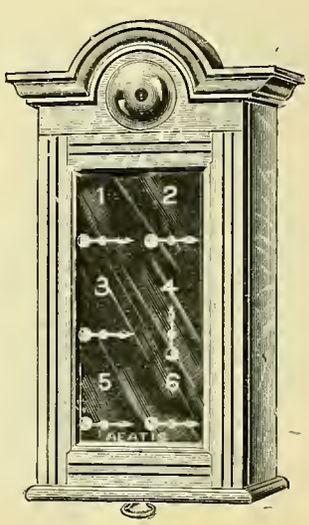


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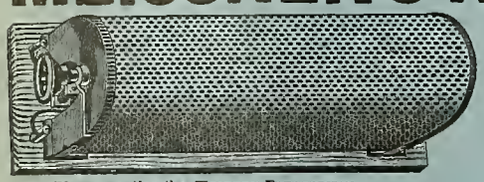

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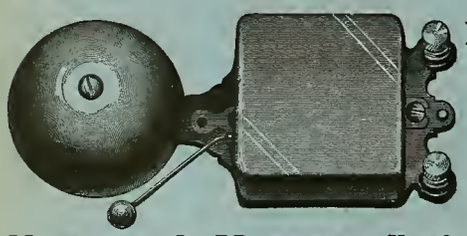

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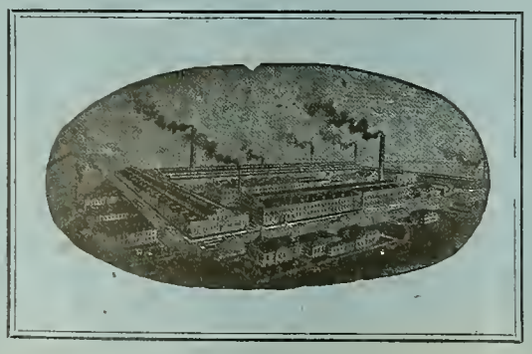

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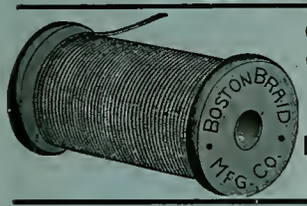


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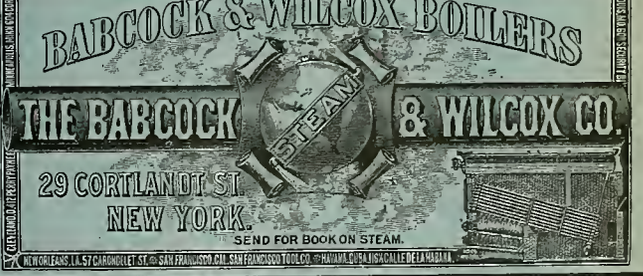


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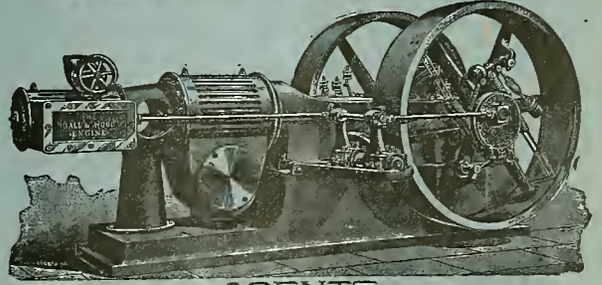

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Southern Engineering Co., Louisville, Ky. James & Company, Chattanooga, Tenn.

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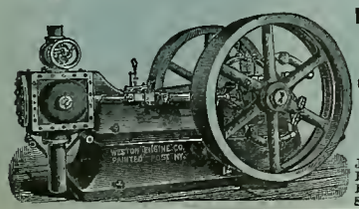

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HAVEMEYER BUILDING, NEW YORK.

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**MOTORS** *From 1-2 H. P. Upwards.*

*All Apparatus Guaranteed as Represented.*

THE EDDY ELECTRIC MFG. CO., WINDSOR, CONN

# THE ALTERNATING CURRENT MOTOR PROBLEM SOLVED.

THE

# MONOCYCLIC SYSTEM,

## A COMPLETE CENTRAL STATION SYSTEM FOR SIMULTANEOUS LIGHT AND POWER.

**Incandescent Lamps, Arc Lamps and Motors Operated from the same Generator Economically and Efficiently.**

### CHARACTERISTICS OF THE MONOCYCLIC SYSTEM:

It operates lights and motors, in parallel, on the same generator and even the same transformer.

It solves the hitherto unsolved problem of the alternating current motor. By the use of this system, alternating current motors may be operated which are not only equal, but superior to continuous current motors. They have a constant speed, are extremely simple and absolutely reliable; and have neither commutator, collector rings, brushes nor moving wires.

Low tension underground networks may be operated on the Edison three wire system and the largest part of copper expended in feeders saved, as it is possible to use high tension feeders and transformers. A better balance is secured and the network may be extended unlimitedly.

It is as simple as the ordinary well-known alternating system. It differs from it only in its ability to operate high grade motors by means of a **THIRD OR POWER WIRE** which is carried only to the motors and resembles the *neutral wire* of the Edison three wire system.

It allows perfect operation of the whole system of generators in parallel and thereby enables the whole lighting and power station to be operated from three bus-bars only, the third intermediate bus-bar being for motor supply.

It will operate, by the use of two transformers, three phase, quarter phase or any other type of alternating current motors.

It gives a perfect regulation of the whole system, as all difficulties caused by self induction or capacity are eliminated. Current may be transmitted over any distance, in consequence of its low frequency—7,200 alternate.

It is operated with generators and transformers of an hitherto unattained efficiency and regulation.

The generators and motors are both slow speed.

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## CLASSIFIED LIST.


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Bradbury-Stone Elec. S. Co.
Cons. Electric St rage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Hascke & Creelman.
Porter & Buerdorf.

**Annunciators.**
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Appliance Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Ind'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Arc Light Cord.**
Samson Cordage Wks.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Central Electric Co.
Electric Appliance Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Hascke & Creelman.
Hayden-Booker Mfg. Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Partrick & Carter Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Washington Electric Co.
Western Electric Co.

**Belting.**
Shultz Belting Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co , The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Fulton Steam Boiler Wks.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electriciau Publishing Co.

**Brushes.**
Partridge Carbon Co.
Wirt, Chas.

**Burglar Alarms.**
Central Electric Co.
Electric Appliance Co.
Metropolitan Electric Co.
Partrick & Carter Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric.** (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Cushing & Morse.
Eastern Electric Cable Co.
Hill, W. S. Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons, Points & Plates.**
Central Electric Co.
General Electric Co.
Jennings, A. R.
Metropolitan Electric Co.
Partridge Carbon Co.
Reisinger, Hugo.
Western Electric Co.

**Car-Heaters, Electric.**
Consolidated Car-Heating Co.

**Castings.**
Dutcher Co., J. A. & P. E.

**Clocks, Electric.**
Self-Winding Clock Co.

**Conduits.**
Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Muncie Elec. Mfg. Co.
Washington Electric Co.
Wirt, Chas.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co , J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co. The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cordage.**
Samson Cordage Wks.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Electric Appliance Co.
Hubley Mfg. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Economizers.**
Fuel Economizer Co.

**Elec. Heating Devices.**
Am. Electrical Heater Co.
Consolidated Car Heating Co.

**Electric Railways.**
Brush Electric Co.
General Electric Co.
Hubley Mfg. Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Roberts & Co., E. P.
Rushmore, S. W.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Diamond Electric Co.
Electric Appliance Co.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co
Sweet Elec. & Mfg. Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng. & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Engravers.**
Illinois Engraving Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Central Electric Co.
Interior Conduit & Ins. Co.
Muncie Elec. Mfg. Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co
Partrick & Carter Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. Supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
General Electric Co.
Hayden-Booker Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Caoot Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Palmer Bros.
Partrick & Carter Co.
Porter & Buerdorf.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Hubley Mfg. Co.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.
Hubley Mfg. Co.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

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Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
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Kartavert Mfg. Co.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Vulcanized Fibre Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co..J. H.
Central Electric Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Hubley Mfg. Co.
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New York Insulated Wire Co.
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Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec.Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
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Partrick & Carter Co.
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Westinghouse Elec & Mfg.Co.

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Westinghouse El. & Mfg. Co.

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C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
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Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
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Siemens & Halske Elec. Co.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co.

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Standard Paint Co.

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Phosphor Bronze Sm.Co. Ltd.

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Morris, Tasker & Co.
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Phœnix Glass Co.

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Electrician Publishing Co.

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Central Electric Co.
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Metropolitan Electric Co.
Partrick & Carter Co.

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General Electric Co.
Rushmore, S. W.

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Klipstein, A. & Co.
Law Battery Co.

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Rushmore, S. W.

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**Slate.**
Independent Electric Co.
Jennings, A. R.

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Electric Appliance Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

**Speed Indicators.**
Diamond Electric Co.
Whitney Elec. Instrument Co

**Steam Heating.**
Gouhert Mfg. Co.
Webster & Co., Warren.

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Worthington, Henry R.

**Storage Batteries.**
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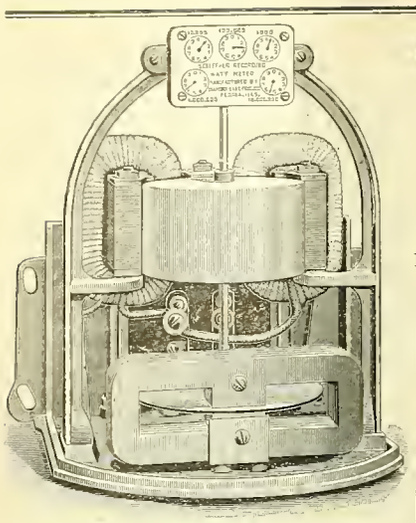

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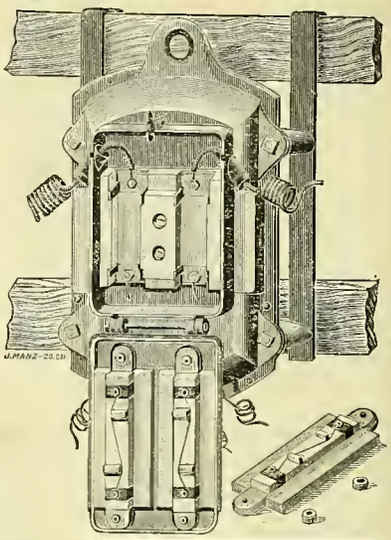

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**The Generator has no moving wire, and excels all others in simplicity, Efficiency and Regulation.**

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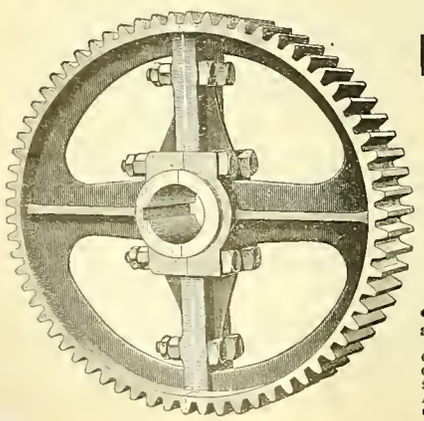

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THIS IS THE IMPROVED NUTTALL TROLLEY.

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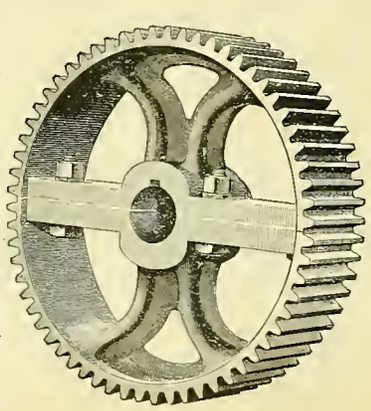

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**a survival of the fittest**

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**its law is progress; a point which yesterday was invisible is its goal today, and will be its starting point tomorrow.**

We are the General Western Agents for the INTERIOR CONDUIT Supplies, and are prepared to make prompt and complete shipments in any quantity.

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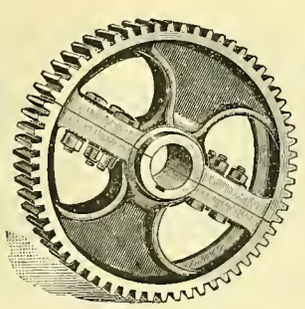

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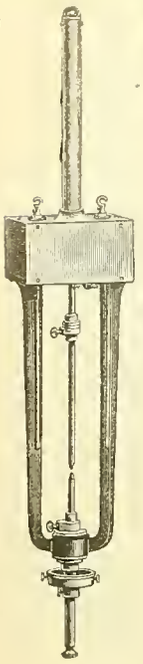

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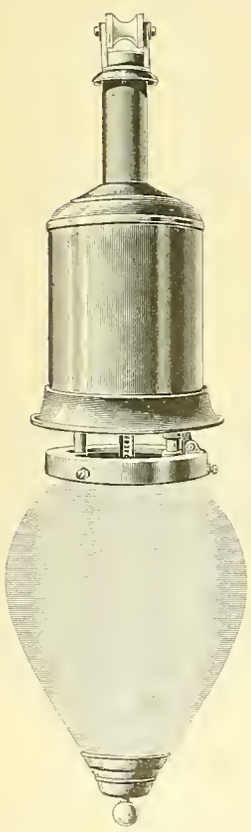

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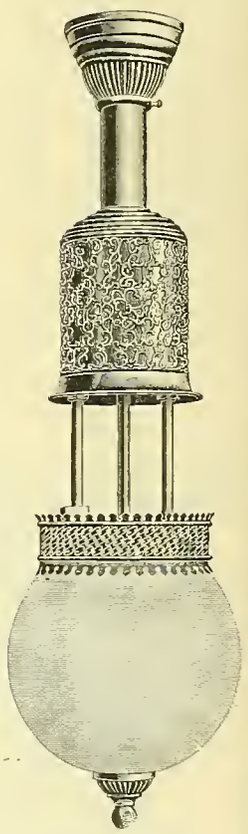

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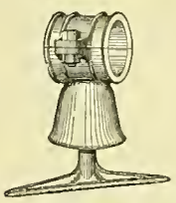

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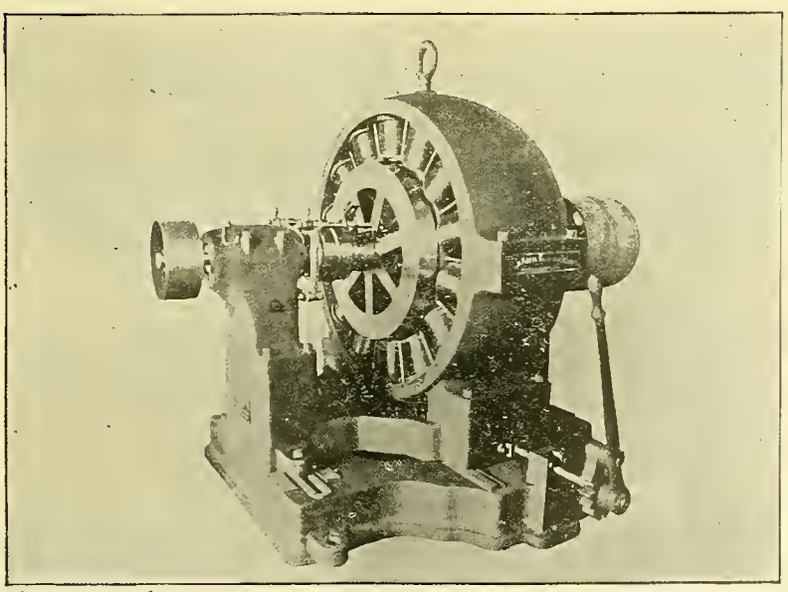

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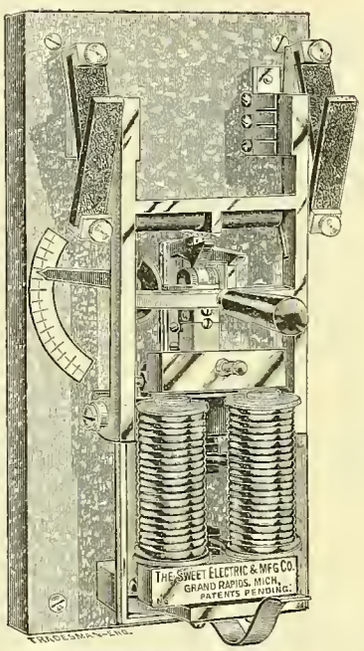
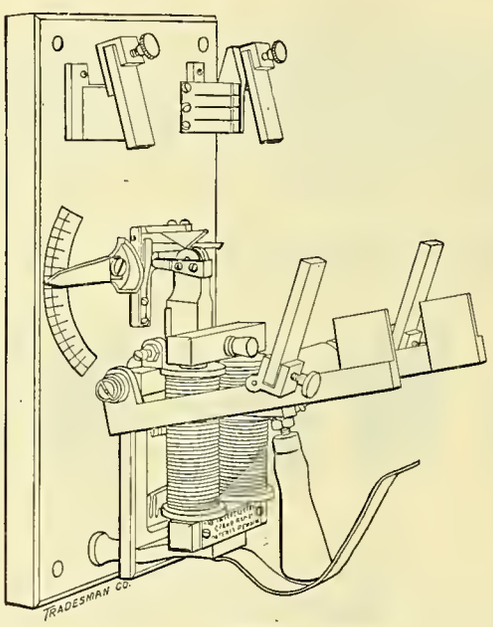



BEFORE ACTION.

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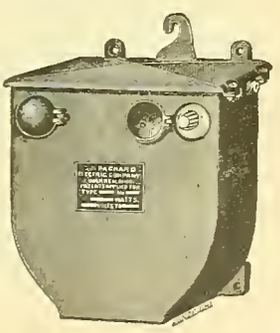

WIRES AND CABLES

WIRES AND CABLES

WIRES AND CABLES

WIRES AND CABLES

WIRES AND CABLES

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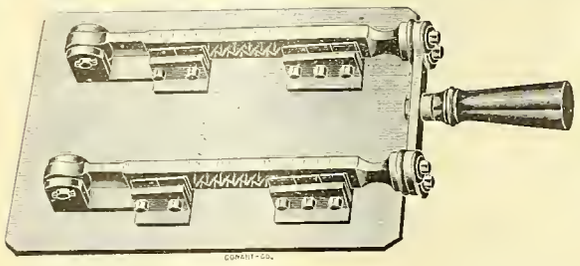

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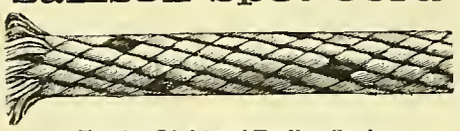

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Direct and Alternating. For Switchboard Work.
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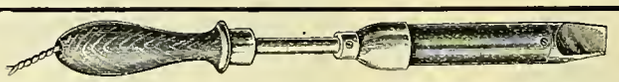

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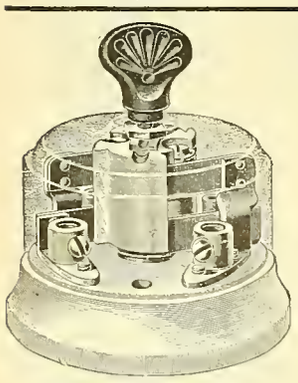

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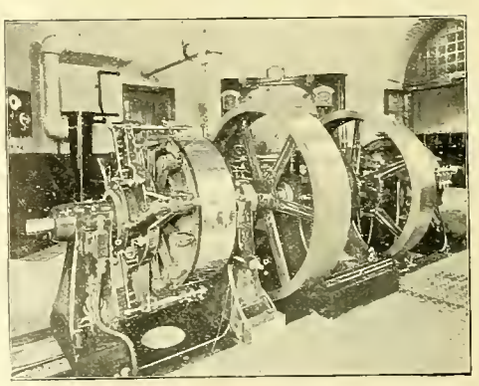

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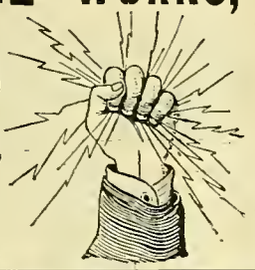

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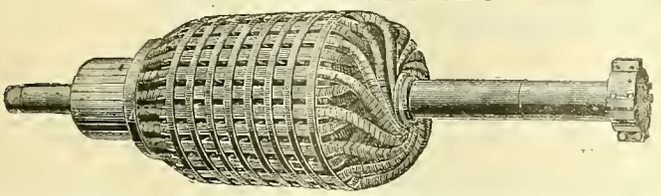

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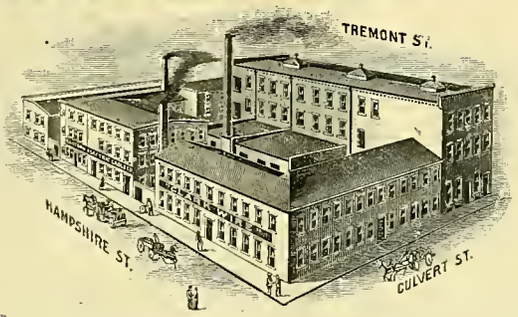


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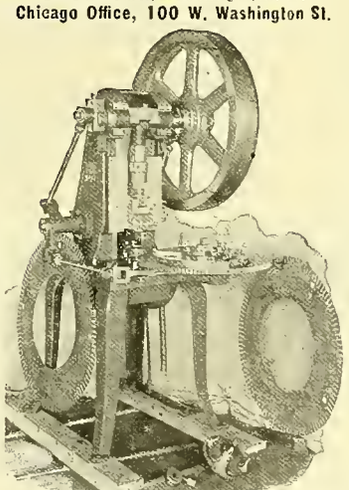
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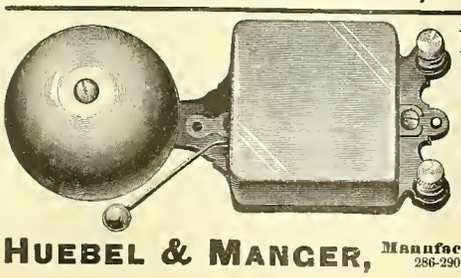
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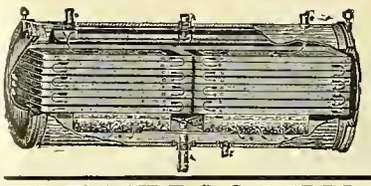
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Any further information desired will be furnished by the Chairman of the Committee. The Council reserves the right to reject any or all bids.
JOHN MEE,
Chairman Light Committee.

## Sale of Electrical Works.
Notice is hereby given that pursuant to the decree and order of the circuit court of Delaware county, Indiana, made at its September term, 1894, in cause No. 8195 therein, in which Frederick A. Van Namee is plaintiff and James Chamberlain is defendant, as Receiver appointed by said court after the 16th day of October, 1894, I will sell, by private contract, to the highest and best bidder, free and clear from any and all liens, as one whole parcel, all the machinery, manufactured machines, motors and dynamos, machines in process of manufacture, tools, implements, stock of material, office furniture and all other tangible property constituting the plant and manufactory of the Muncie Electrical Works. Such sale to be subject to confirmation by the court aforesaid and will be made at the office of C. E. Shipley, attorney, southeast corner of Walnut and Jackson streets, city of Muncie, Indiana, where, or at Nickey's drug store, southwest corner of Main and Mulberry streets, Muncie, Indiana, I will receive bids.
TERMS OF SALE:—One-half cash; one-fourth payable in three months and one-fourth payable in six months from the day of sale; deferred payments to bear six per cent. interest from date till due and secured by note of the purchaser with good approved security.
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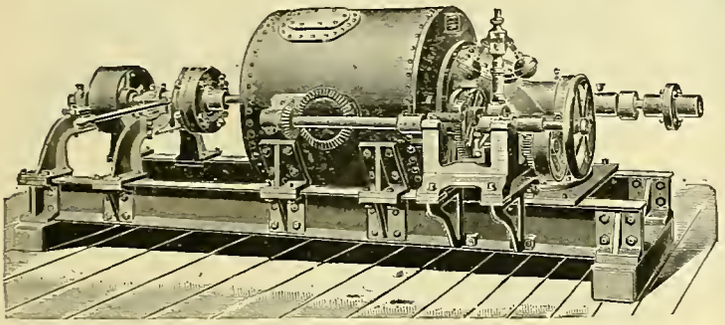

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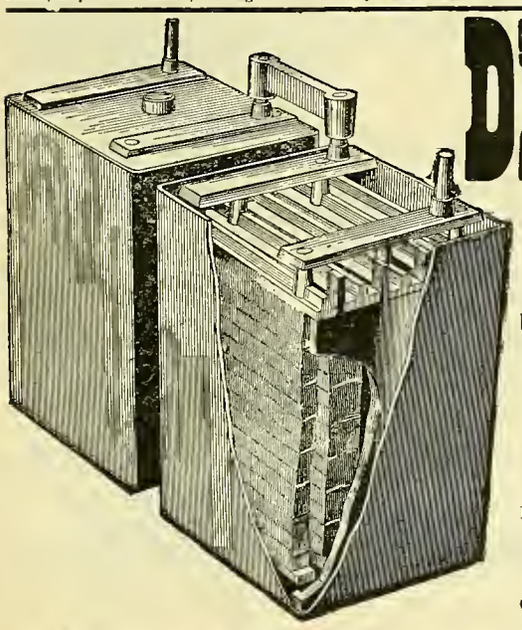

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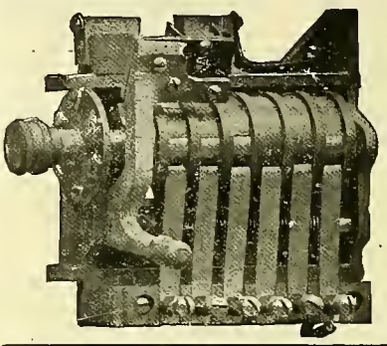

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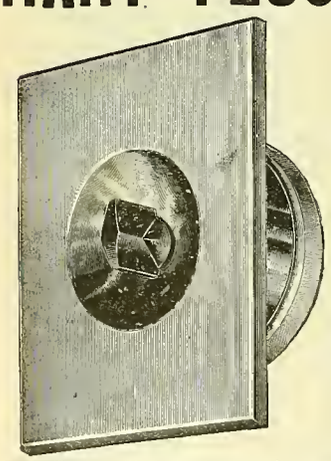

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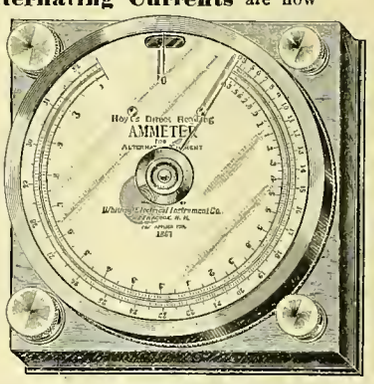


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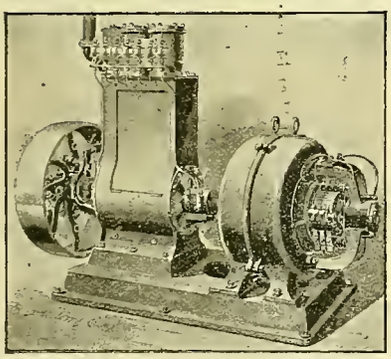

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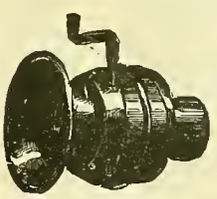

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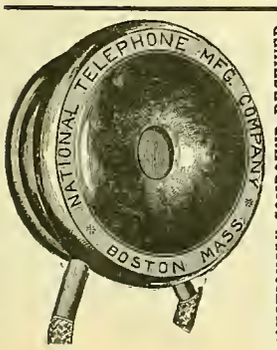


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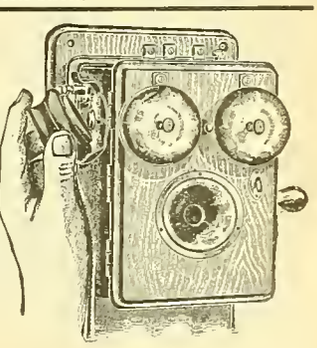

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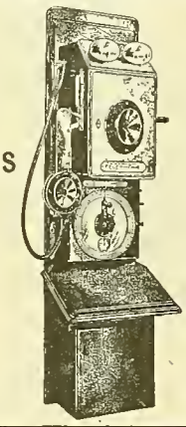

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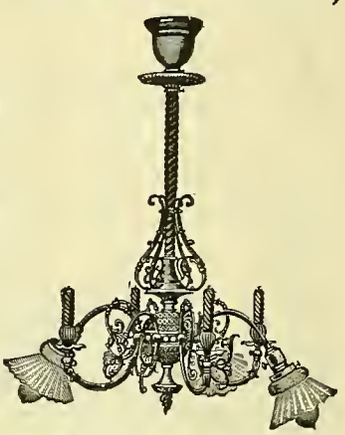

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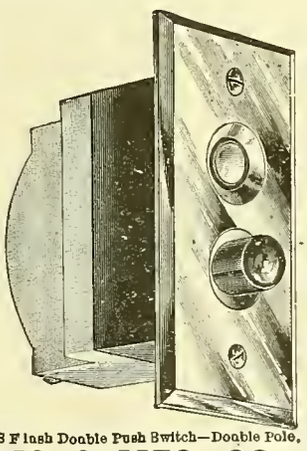

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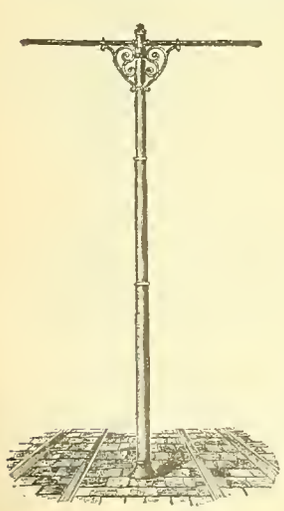

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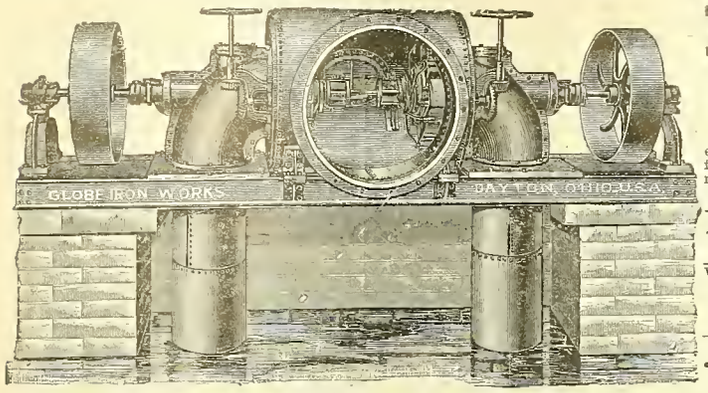


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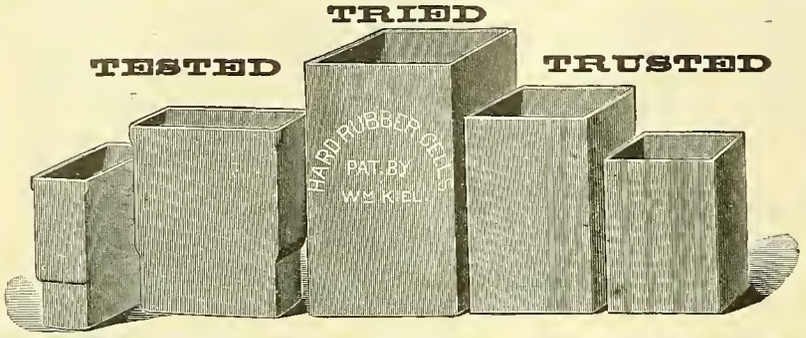


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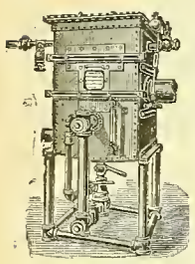

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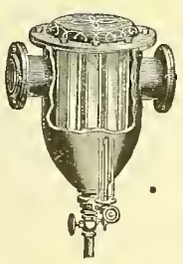

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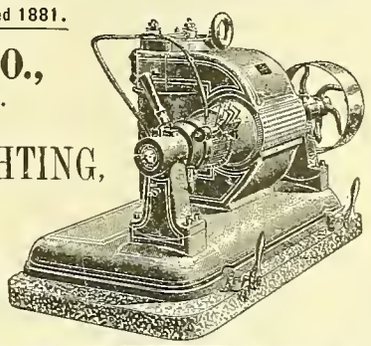

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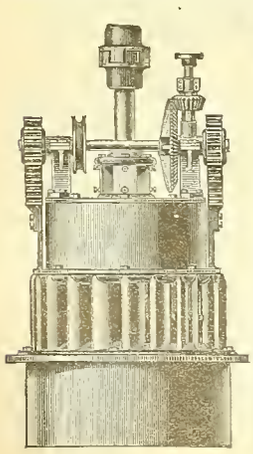

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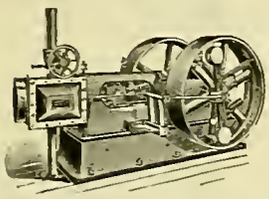

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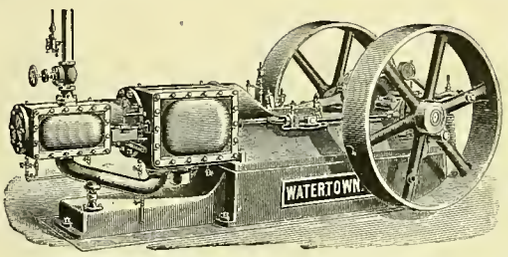


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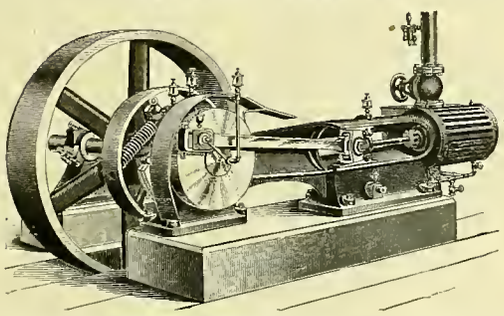

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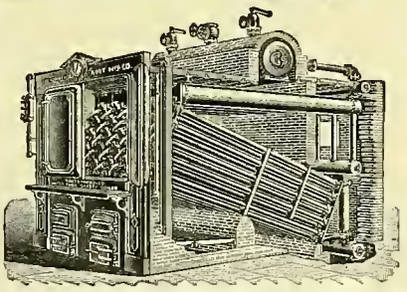

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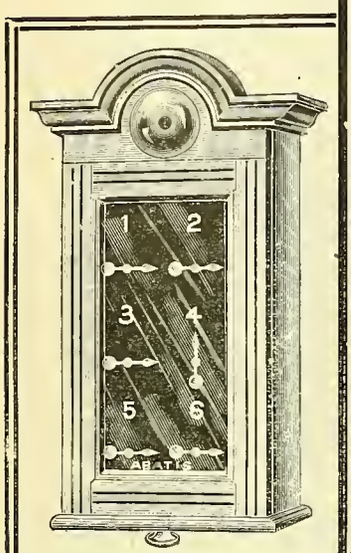

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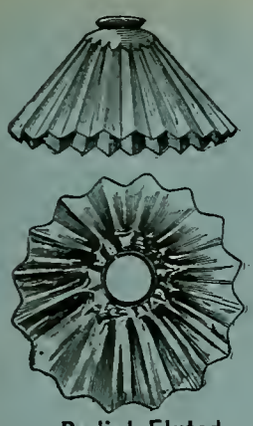

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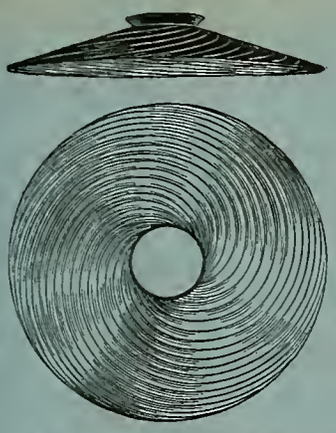

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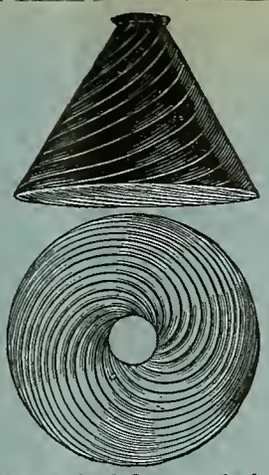

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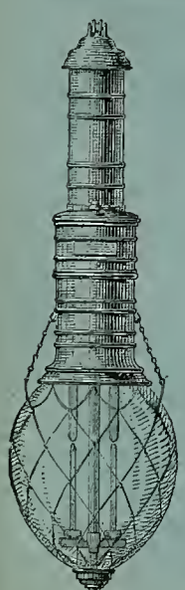

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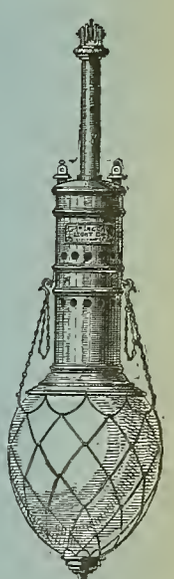

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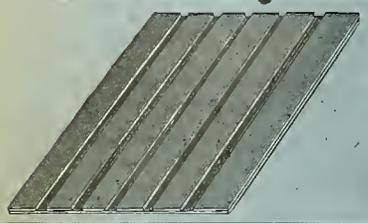

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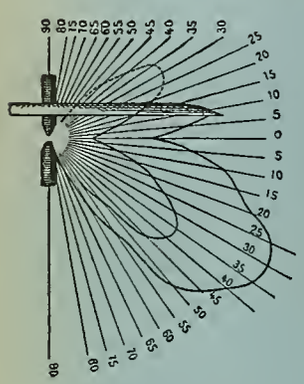


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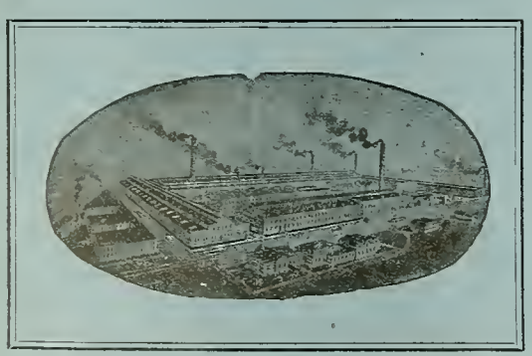

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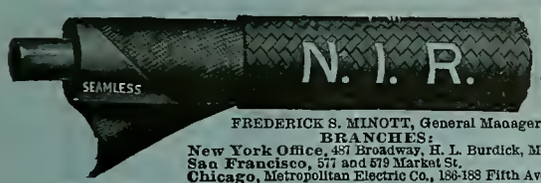


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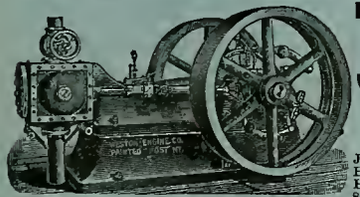

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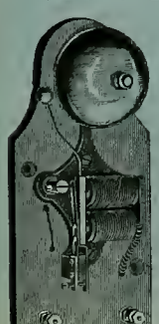

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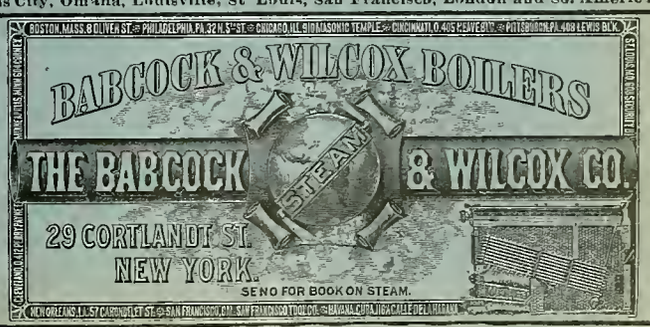


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Siemens & Halske Elec. Co. —
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Sioux City Brass Works. —
Sioux City Engine & Iron Works. xx
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Stilwell-Bierce & Smith-Vaile Co. xiv, xv
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Western Telephone Construction Co. xv
Westinghouse Elec. and Mfg. Co. xix
Weston Engine Co. i
Whitney Electrical Instrument Co. viii
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## CLASSIFIED LIST.


**Accumulators.**
Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

**Annunciators.**
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
Auerbach-Woolverton El. Co.
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Arc Light Cord.**
Samson Cordage Wks.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Central Electric Co.
Electric Appliance Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Hayden-Booker Mfg. Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Partrick & Carter Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Western Electric Co.

**Belting.**
Shultz Belting Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co., The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Fulton Steam Boiler Wks.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electrician Publishing Co.

**Brushes.**
Partridge Carbon Co.

**Burglar Alarms.**
Central Electric Co.
Electric Appliance Co.
Hoggson & Co.
Metropolitan Electric Co.
Partrick & Carter Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric.** (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Cushing & Morse.
Eastern Electric Cable Co.
Hill, W. S. Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roehling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons, Points & Plates.**
Central Electric Co.
General Electric Co.
Jennings, A. R.
Metropolitan Electric Co.
Partridge Carbon Co.
Reisinger, Hugo.
Western Electric Co.

**Car-Heaters, Electric.**
Consolidated Car-Heating Co.

**Castings.**
Dutcher Co., J. A. & P. E.

**Clocks, Electric.**
Self-Winding Clock Co.

**Conduits.**
Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation
Muncie Elec. Mfg. Co.
Washington Electric Co.
Wirt, Chas.

**Contractors and Electric Light Plants.**
Allen-Bussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co, J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co. The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cordage.**
Samson Cordage Wks.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Electric Appliance Co.
Hubley Mfg. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Economizers.**
Fuel Economizer Co.

**Elec. Heating Devices.**
Am. Electrical Heater Co.
Consolidated Car Heating Co.

**Electric Railways.**
Brush Electric Co
General Electric Co.
Hubley Mfg. Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Rushmore, S. W.
Wirt, Chas.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bristol Co., The.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Diamond Electric Co.
Electric Appliance Co.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Large & Twining.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co
Sweet Elec. & Mfg. Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng. & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Engravers.**
Illinois Engraving Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Central Electric Co.
Interior Conduit & Ins. Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Feed Water Heaters.**
Gonbert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Metropolitan Electric Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co
Partrick & Carter Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. Supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Holtzer-Caoot Electric Co.
Hubley Mfg. Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Palmer Bros.
Partrick & Carter Co.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Hubley Mfg. Co.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.
Hubley Mfg. Co.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Induction Coils.**
Splitdorf, C. F.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Vulcanized Fibre Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Hubley Mfg. Co.
Independent Electric Co.
Large & Twining.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Jennings, A. R.
Mather Electric Co.
Metropolitan Electric Co.
New York & Ohio Co.
Partrick & Carter Co.
United Elec. Imp. Co.
Westinghouse Elec. & Mfg. Co.

**Lightning Arresters.**
Central Electric Co.
Diamond Electric Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Wirt, Chas.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery.**
Bliss Co., E. W.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

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Bolgiano Mfg. Co.
Brush Electric Co.
C & C Electric Co
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co
Muncie Elec. Mfg. Co.
Palmer Bros.
Porter & Buerdorf.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
Stanley Elec. Mfg. Co.
Wallace Electric Co.
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Morris, Tasker & Co.
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General Electric Co.
Phœnix Glass Co.

**Publishers, Electrical.**
Electrician Publishing Co

**Push Buttons.**
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Partrick & Carter Co.

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General Electric Co.
Rushmore, S. W.

**Sal Ammoniac.**
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Rushmore, S. W.

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**Silk Braid.**
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**Slate.**
Independent Electric Co.
Jennings, A. R.

**Speaking Tubes.**
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

**Speed Indicators.**
Diamond Electric Co.
Whitney Elec. Instrument Co

**Steam Heating.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Steam Pumps.**
Worthington, Henry R.

**Storage Batteries.**
Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

**Street Cars.**
Brill, J. G. Co.

**Tapes, Insulating.**
American Electrical Works.
Central Electric Co.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus**
Central Electric Co.
Electric Appliance Co.
Metropolitan Electric Co.
Partrick & Carter Co.
Western Electric Co.

**Telephones.**
D'Unger Long Dist. Tel. Co.
Harrison Int. Telephone Co.
Imperial Telephone Wks.
Metropolitan Electric Co.
National Telep. Mfg. Co.
Palmer Bros.
Partrick & Carter Co.
Western Electric Co.
Western Tel. Const. Co.

**Telephone Hooks.**
Bradley & Co.

**Transformers.**
Diamond Electric Co.
General Electric Co.
Hornberger Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Jennings, A. R.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Trolley Cord.**
Samson Cordage Wks.

**Trucks, Electric Car.**
General Electric Co.
Westinghouse El. & Mfg. Co.

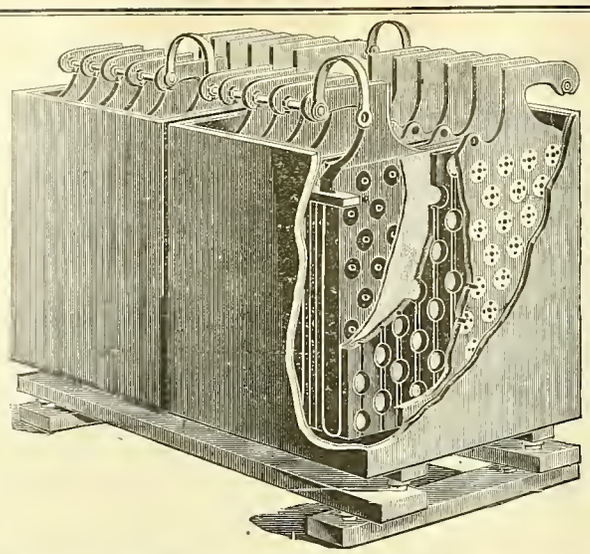
**Turbine Wheels.**
Dayton Globe Iron Works Co
Leffel & Co., Jas.
Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

**Universities.**
Cor. School of Industrial Sciences.
Scientific Machinist Co.

**Varnishes.**
Standard Paint Co.

**Water Wheels.**
Leffel & Co., Jas.
Smith, S. Morgan.

**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Electric Appliance Co.
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.



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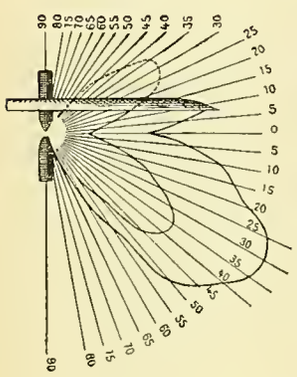

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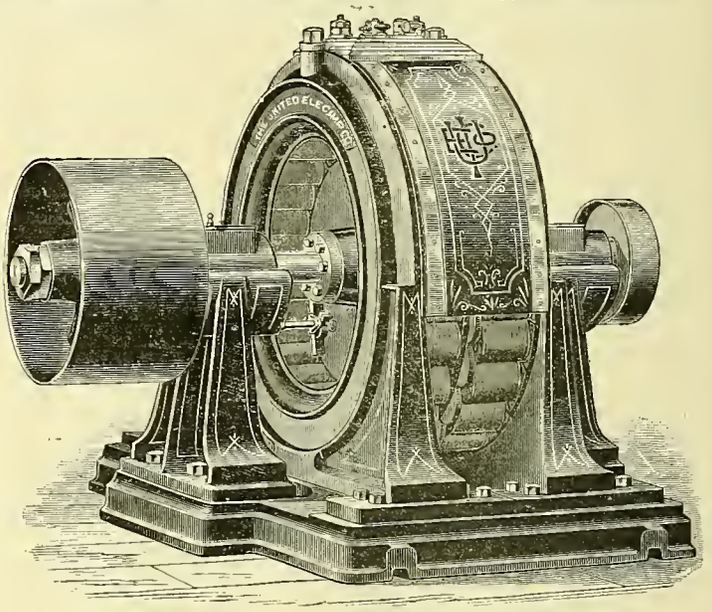

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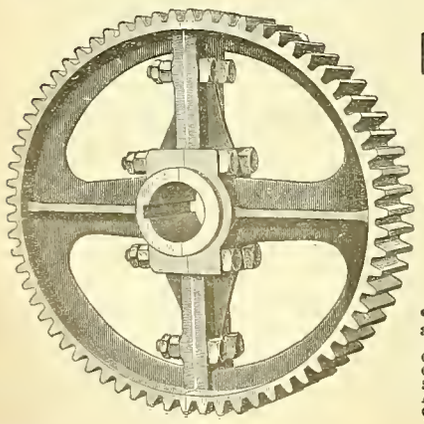

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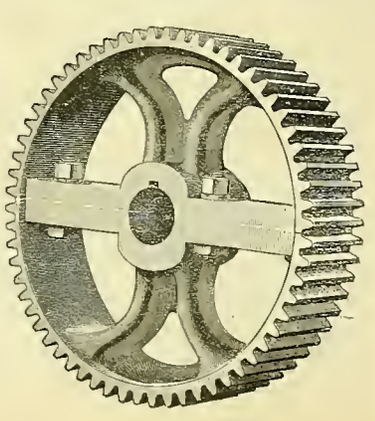

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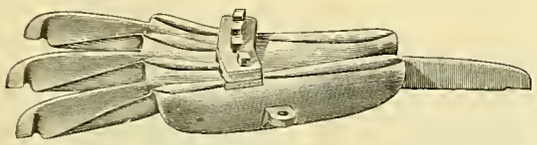
CHAS. A. CAVAGNA, Neave Building, Cincinnati, Ohio, Central States Sales Department.

It isn't necessary for us to croak much about



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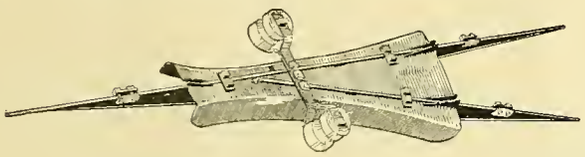
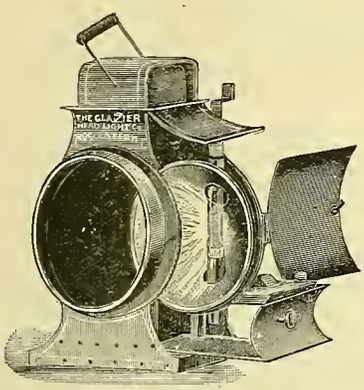


are as lightly constructed as consistent with strength.



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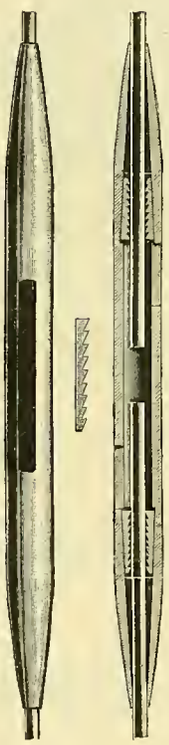

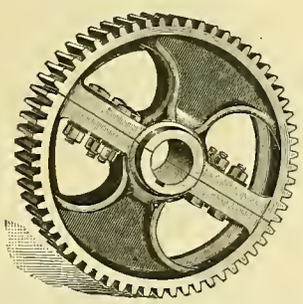

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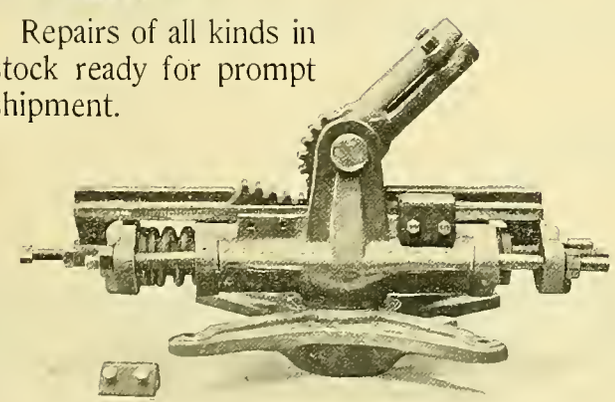


The Chicago Trolley Base is the most simple, durable and practical of any.

# We've got the grip

on the finest line of

## *Street Railway*

material that ever found a temporary abiding place in a Chicago store. We repeat what we said two weeks ago, that the aim has been and will be to select those devices which do the work in the simplest manner with the least amount of mechanism.

Quality is considered paramount to price, but the prices have been stripped of every fancy frill. If we can succeed in satisfying you with the quality first, we know we can satisfy you with the price.

Our general stock of

### *Electrical Supplies*

is the largest in the world.

We are the General Western Agents for

**OKONITE WIRES,**
**INTERIOR CONDUIT,**
**LUNDELL FANS,**
**HELIOS ARC LAMPS,**
**WASHINGTON CARBONS,**
**CARPENTER ENAMEL RHEOSTATS.**

OKONITE TRADE MARK.

## Central Electric Company,

173-175 ADAMS STREET, - CHICAGO, ILL.

BRANCHES: { St. Louis: Southern Electrical Supply Co., Kansas City: Gate City Electric Co.

# A Brand New Arc Lamp.

# THE A.-W. ARC LAMP.

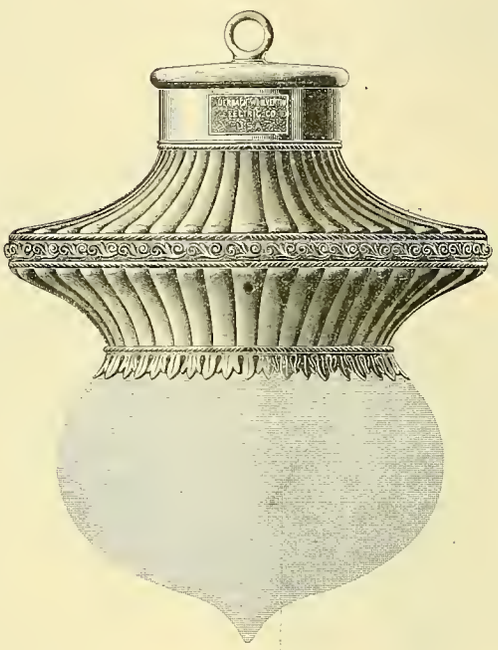
That burns on any current.

That measures 18 inches from top to bottom (including globe).

That has a life of 25 hours in the open air.

That throws light where you want it---on the ground.

That feeds neither by rack, clutch, clockwork, nor chain.



That casts no shadow whatever.

That gives the maximum light distribution.

That gives an absolutely steady light.

That keeps the arc stationary.

That feeds independent of the magnet.

## Simplicity and Durability of Construction.
## The Most Ornamental Lamp in the Market.

# AUERBACH-WOOLVERTON ELECTRIC CO.,

Cable Building, Houston St. and Broadway,

NEW YORK CITY.

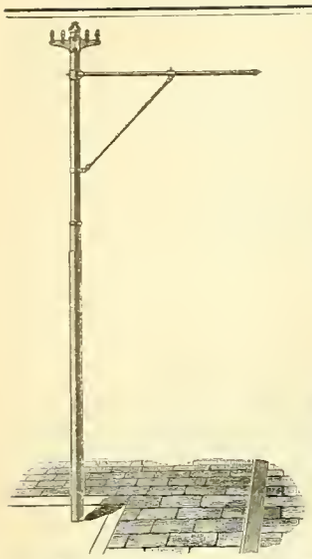
# INFRINGEMENT!

## Victory for The Accumulator Company.

The Edison Electric Illuminating Co. of New York was, on Monday, October 8, enjoined by Judge Lacombe from using Chloride Accumulators manufactured by the Electric Storage Battery Co. of Philadelphia, pronounced by him to be an infringement of the Accumulator Co.'s patent.

## THE ACCUMULATOR COMPANY,

224 Chestnut Street, PHILADELPHIA, PA.



1821. 1888.

# MORRIS, TASKER & CO.,

INCORPORATED.

Offices, 222-224 S. Third St., Philadelphia, Pa.

PASCAL IRON WORKS, PHILADELPHIA.

DELAWARE IRON WORKS, NEW CASTLE, DEL.

Manufacturers of

## Boiler Tubes, Wrought Iron Pipes and Fittings

ELECTRIC LIGHT and RAILWAY PIPE POLES A SPECIALTY.

## HART FLUSH SWITCHES.

5 and 10 Ampere Single Pole.
10 Ampere Double Pole.
10 Ampere Three-way.

The Only Snap Switch that has PROVEN A SUCCESS.

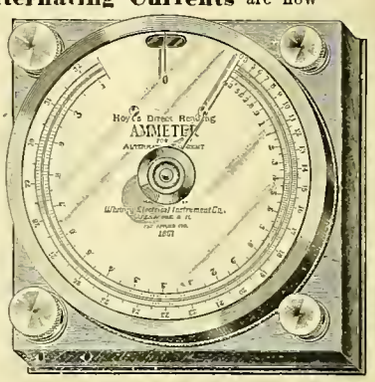
For Sale by All Supply Houses.

The Hart & Hegeman MANUFACTURING CO., HARTFORD, CONN.

## Something New.

The **Hoyt Standard Ammeters** and **Voltmeters** for **Lamp** and **Meter** measurement on **Alternating Currents** are now ready for the market.

Send for our **1894 Catalogue** which contains the above and other new instruments of our manufacture.




Whitney Electrical Instrument Co.,

PENACOOK, N. H.

Factories: Penacook, N. H.; Sharbrooke, P. Q., Can.

AGENTS:

HENRY F. KELLOGG, General Selling Agent.

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Boston, Mass.: Warren S. Hill.
Boston, Mass. (New England): W. B. Southgate & Co., 146 Franklin St.
Chicago, Ill.: Electric Appliance Co.
Cincinnati, O.: Nowotny Electric Co.
Halifax, N. S.: John Starr, Son & Co., Ltd.
New York City: Geo. L. Colgate, 136 Liberty St.
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# We Want Western Business.

## LA ROCHE ALTERNATORS.

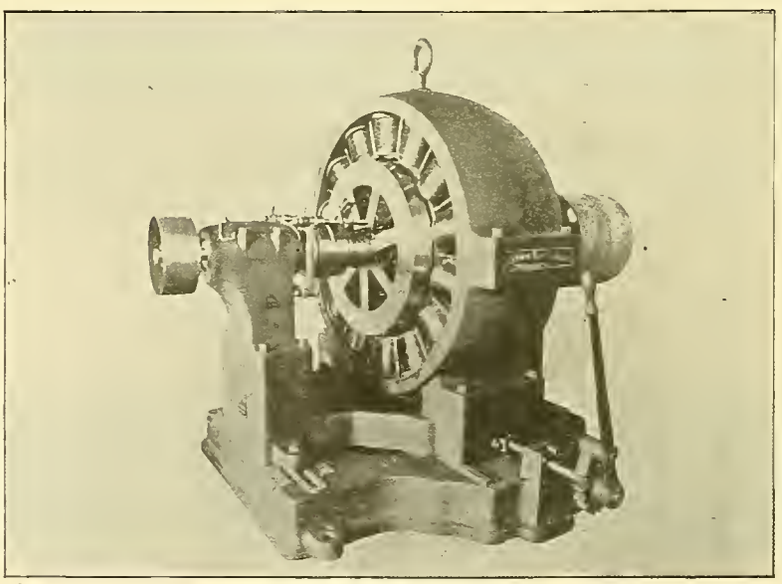
Manufactured in Sizes from

25 to 5,000 Lights,

SINGLE OR MULTIPHASE.

Direct Connected Dynamos.

Direct Current Generators



1,000 Light Alternator.

LA ROCHE ELECTRIC WORKS,

PHILADELPHIA, PA.

DISTRICT OFFICES:

New York, Boston, Knoxville, Cincinnati, Pittsburg, San Francisco, Chicago, St. Louis, Mobile.

WM. HOOD, 239 La Salle St., Chicago.

OWEN FORD, Rialto Bldg., St. Louis, Mo.

The Chloride Electrical Storage Syndicate, Limited, Manchester, England.

Societe Anonyme Pour le Travail Electrique des Metaux, Paris, France.

# The Only Storage Battery in Use in Central Stations of American Manufacture.

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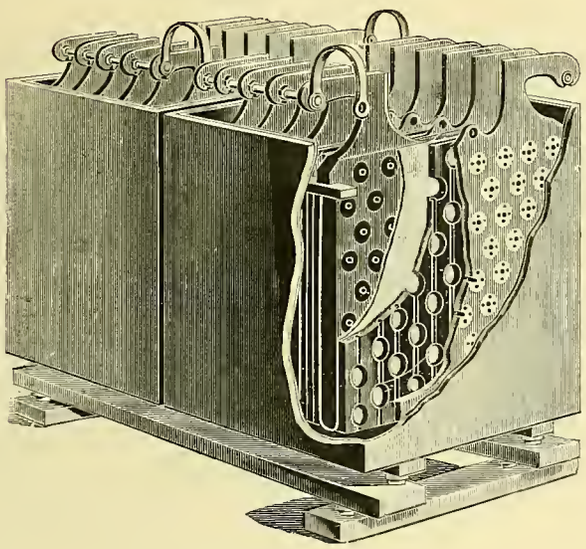
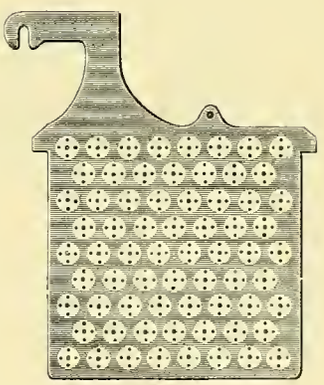
# The Electric Storage Battery Co.,

## DREXEL BUILDING, PHILADELPHIA, PA.





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# CHLORIDE ACCUMULATOR.

Registe.ed S.ptember 11th, 1894.

## Electrical Storage Cells of any Desired Capacity.

CATALOGUES GIVING CAPACITIES, DIMENSIONS, WEIGHTS, PRICES, ETC., ON APPLICATION.

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MANUFACTURERS OF

## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

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Works: CARWOOD, N. J.
on CENTRAL R. R. of N. J.

BRANCH OFFICES: { CHICAGO, 1020 and 1021 Monadnock Building. BOSTON, 63 Oliver St.
{ CLEVELAND, Cuyahoga Building. PHILADELPHIA, 633 Arch St.

# ROYAL ELECTRIC CO., PEORIA, ILL.

MANUFACTURERS OF

## The Most Reliable ALTERNATING System now on the Market.

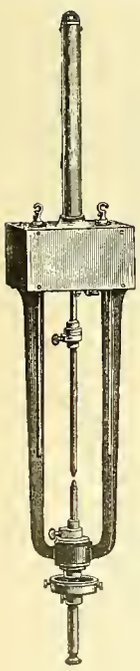
OUR ALTERNATOR HAS:

NO COLLECTING RINGS. NO COMMUTATOR. NO REVOLVING FIELD OR ARMATURE COILS.

Step Down TRANSFORMERS. Step Up TRANSFORMERS.

TRANSFORMERS for any desired Voltage. Arc Light TRANSFORMERS. Direct Current Generators and Motors.

CORRESPONDENCE SOLICITED.



# STANDARD "WARD" LAMPS

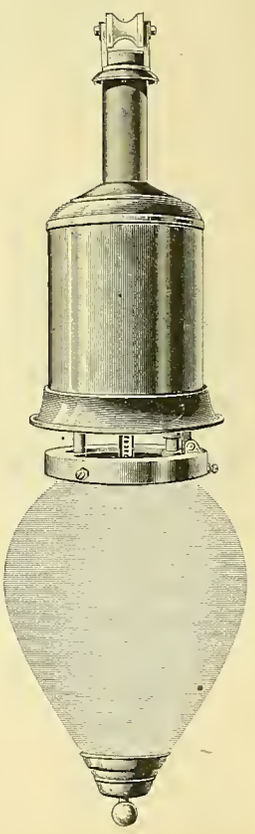
For Direct Current, 110 Volts.

## TEN DOLLARS EACH

With Globe and Resistance, $2.00 Extra.

There are more lamps of the above type in use in the United States on Incandescent Circuits, than all other makes combined.

## Send in Your Orders Quickly!



### ALTERNATING LAMPS.

Our new Alternating Lamp is the most economical and surest feed lamp on the market, burning from secondary circuits of 33, 50 or 100 volts.

Simplicity and strength of construction are the strong points of our lamps, rendering them more durable and easier to maintain than any others.

Lamps ENTIRELY WATERPROOF, dispensing with the use of hoods.

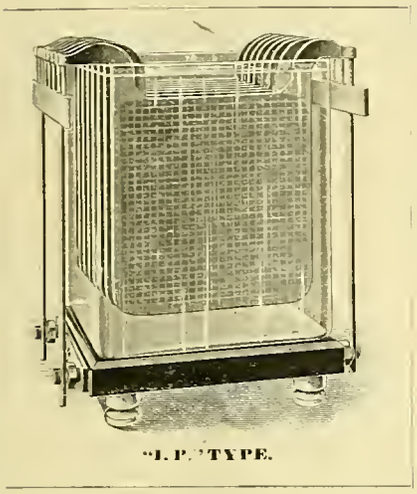
Write us for description and circular.

## ELECTRIC CONSTRUCTION & SUPPLY CO.,

Established 1881. 18 Cortlandt Street, New York.

WALLACE ELECTRIC CO., Agents, 307 Dearborn St., Chicago, Ill.

# Accumulator Company.



"L. P." TYPE.

## STORAGE BATTERIES FOR CENTRAL STATIONS SUPPLYING LIGHT AND POWER.

New Type with Independent Plates which can be Easily Examined and Replaced without interfering with Charge or Discharge. Capacity from 350 to 12,000 Ampere Hours. No Nuts, Bolts or Screws. Meets all Requirements of Central Stations.

## SPECIAL TYPES FOR VARIOUS PURPOSES.

*STREET CAR TRACTION,*
*ELECTRIC LAUNCHES,*
*YACHT LIGHTING,*
*PHONOGRAPHS,*
*ELECTRO-PLATING,*
*ELECTRIC WELDING,*
*CAUTERY BATTERIES,*
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**General Offices: 224 Chestnut Street, Philadelphia, Pa.**

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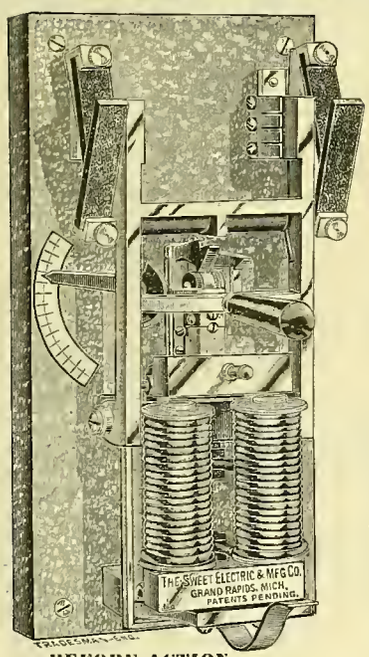


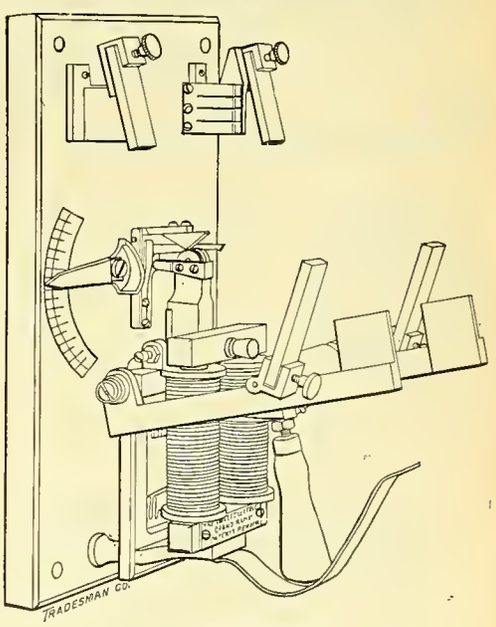

BEFORE ACTION.

Central Stations, Electric Railways, Isolated Lighting and Power Plants

HAVE YOU SEEN

## THE SWEET Limit Switch?

**DO YOU KNOW ITS USE AND VALUE?**




AFTER ACTION.

You insure your building, why not insure your machine? Write to

## THE SWEET ELECTRIC & MFG. CO., GRAND RAPIDS, MICHIGAN,

AND YOU'LL LEARN THE COST.

## Staple Articles

Because we are continually calling attention to our most desirable line of specialties, do not

## Get the Idea

that we are not strictly "in it" on the regular staple goods which are a part of every supply order. We are of course very **proud of our line of specialties,** but we also pride ourselves on having the brightest, most complete

## Up=to=Date

stock of electrical supplies in the West and **guarantee lowest prices and promptest shipments.**

Yours for business,

**ELECTRIC APPLIANCE COMPANY,**

242 MADISON STEET, CHICAGO.

# WIRT INDICATORS.

**Direct and Alternating. For Switchboard Work.**
**Direct Reading. Amperes up to 1,000. Volts up to 3,000.**
**Accurate, Reliable, Unchangeable, Handsome.**

Write for quotations to your dealer, or to

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**—$1.00.—**

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For all Purposes.
Scrap and Native Platinum Purchased.
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Annunciators, Bells, Batteries,
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**WHITE OAK PINS.**
**It will pay you to get our prices.**
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Manufactured, Repaired, Recharged.
Rented and Sold.
**D. E BOSWELL & CO.,**
154 Lake Street, - CHICAGO

**Steel and Wrought Iron Castings.**
The strongest castings made. The wrought iron castings are very desirable for electrical purposes.
**J. A. & P. E. Dutcher Co.,**
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The **Wirt Dynamo Brush.**
Suitable for all Incandescent Dynamos, P'ating Dyoamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.
**WALLACE ELECTRIC CO.,**
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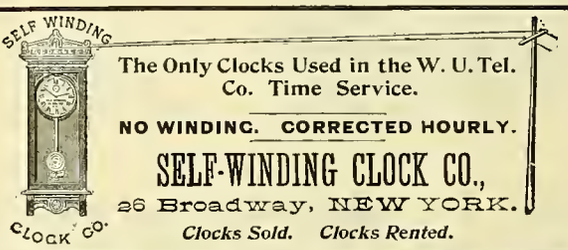


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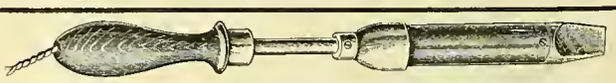
NO WINDING. CORRECTED HOURLY.
**SELF-WINDING CLOCK CO.,**
26 Broadway, NEW YORK.
*Clocks Sold. Clocks Rented.*

**Send for Samples and Prices.**
**Samson Spot Cord.**

For Arc Light and Trolley Cord.
SAMSON CORDAGE WORKS, BOSTON, MASS.



# THE LATEST IN ELECTRIC Soldering Irons.

Write for Circulars descriptive of
**NEW ELECTRIC HEATING DEVICES.**
**American Electrical Heater Co.,**
45 STATE STREET, DETROIT, MICH.

**BINDERS** —FOR THE— **WESTERN ELECTRICIAN,** *ONE DOLLAR.*

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**ESTABLISHED 1873.**
**SOLE MANUFACTURERS OF**
**HARD VULCANIZED FIBRE**

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

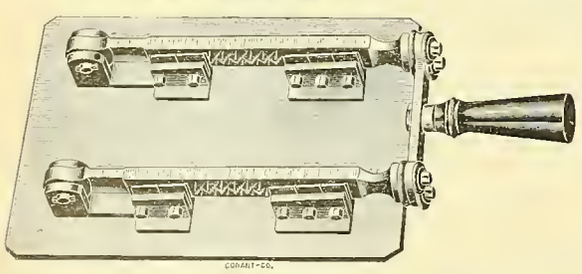
# New York Insulated Wire Co.,

**Sole Manufacturers,**

Grimshaw White Core and Raven Core Wires, Grimshaw Underground Lead Covered Cables,
Competition Line Wires, Grimshaw Tapes and Splicing Compound,
Vulca Bushings, all sizes, Vulca Electrical Wire Ducts for Interior Construction.

**New York Insulated Wire Company,**
MAIN OFFICE: 13-17 Cortlandt Street, New York.
BRANCHES: CHICAGO: 78-82 Franklin Street. BOSTON: 134 Congress Street. SAN FRANCISCO: 102 Sacramento Street.

# W. S. HILL ELECTRIC CO.



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**Switches and Switchboards.**
LATEST AND BEST DESIGNS.
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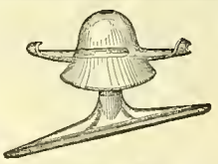
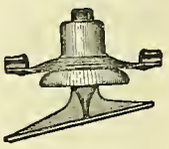
NEW YORK: Elson & Brewster, 143 Liberty St. CHICAGO: Central Electric Co.



# MOULDED MICA



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*Hangers, Pull-Overs, Bracket Arm Insulators, Guard Wire, Feed Wire, Giant Strain and Section Insulators, Frogs, Crossings, Rail Bonds, Etc., Etc.*

**VULCABESTON** heat-proof insulation for Magnet Spools, Bushings, Controller parts, Etc.
**ASBESTOS** for Fire-Proofing and Electrical Purposes.

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*240 and 242 Randolph Street, - CHICAGO, ILL.*
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# AMERICAN ELECTRICAL WORKS,

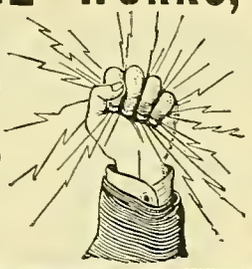
**PROVIDENCE, R. I.**

RAILWAY FEEDER AND TROLLEY WIRE,

ELECTRIC LIGHT LINE WIRE,

Incandescent and Flexible Cords,

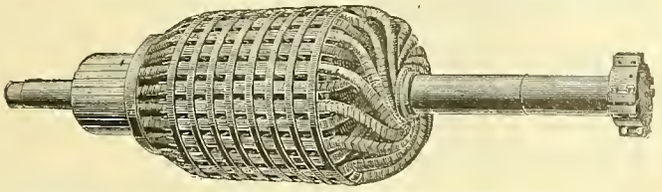
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR FARADAY CABLES. WIRES.



NEW YORK OFFICE, P. C. Ackerman, 10 Cortlandt Street.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works

# COOL HEADED ARMATURES

Are Necessary for All-around Station Economy.



The above cut is of a 175 K. W. Generator wound on our new open-head spiral system. All coils alike, perfect balance, handsome appearance. Write for prices on **HEAVY CENTRAL STATION REPAIRS**; *Large Commutators*, Search Lamps and Station Dynamos.

Shops, Jersey City, N.J. **S. W. RUSHMORE,** 126 Liberty St., NEW YORK.

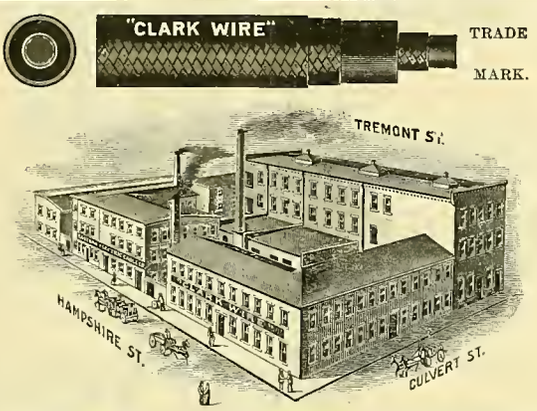
THE

# "CLARK" WIRE.

For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

Western Agents,
GREAT WESTERN MFG. CO.,
Chicago, Ill.




TRADE MARK.

**In a Letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A Thoroughly Reliable and Desirable Wire in every respect."**

The Rubber used in insulating our Wires and Cables is especially chemically prepared, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat.

We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class Insulated Wire.

We shall be pleased to mail Catalogues with Terms and Discounts for Quantities.

**EASTERN ELECTRIC CABLE CO.,**

61 and 63 Hampshire St., Boston, Mass.

HENRY A. CLARK, Treas. and Gen'l Mgr. HERBERT H. EUSTIS, Prest. and Electrician

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ALL KINDS OF PARTS PRICES OF Dynamos and Motors AND PARTS OF SAME TELEPHONES ELECTRICAL SUPPLIES

SEND STAMP FOR CATALOGUE PALMER BROS. COLCHESTER, CONN.

THE
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**BRUSH PATENTS,**
Licenses Granted.
EDISON BUILDING, NEW YORK.
DREXEL BUILDING, PHILADELPHIA.

**SPEAKING TUBES AND WHISTLES.**
Oral, Electric, Pneumatic and Mechanical
**ANNUNCIATORS AND BELLS.**
Full Line Always in Stock.
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HAYDEN-BOOKER MFG COMPANY,
Manufacturers of all kinds of
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And Dealers in
Everything in the Battery Line.
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# STREET LIGHTING FROM ALTERNATING CURRENT DYNAMOS.

**New Prices given on** **Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters**

**And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.**

***This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.***

# OUR SERIES LAMPS

***Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.***

# BERNSTEIN ELECTRIC COMPANY, 620 Atlantic Ave., Boston, Mass.

# "IDEAL" INSULATED COPPER WIRE.

TRADE MARK. WIRES "IDEAL" AND CABLES

**Approved by the New York Board of Fire Underwriters.**

The Only Authorized FIBRE COVERED WIRE for INSIDE, TUBE and CONCEALED WORK GENERALLY.

**It will not Deteriorate by long use, nor Oxidize the Copper. Finished in the following Styles: Black Polished, White and Black Glazed Braid and White Fireproof.**

We can freely recommend this Wire for all inside wiring, from the fact that recent insulation tests made by reliable authorities show that it stands very high.

**PHILLIPS INSULATED WIRE COMPANY,**

Chicago Agents, ELECTRIC APPLIANCE CO.
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# COMBINATION AND ELECTRIC FIXTURES.

First-Class Goods Only.

CHICAGO GENERAL FIXTURE CO.,
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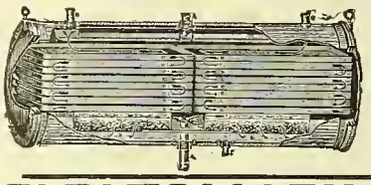

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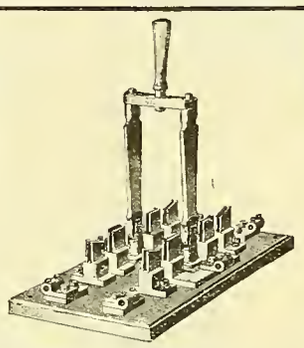

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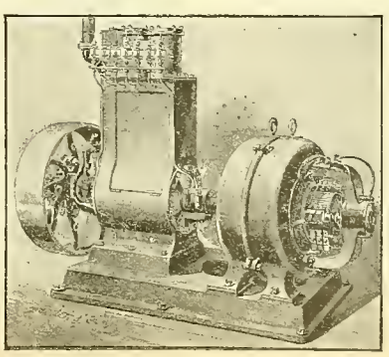

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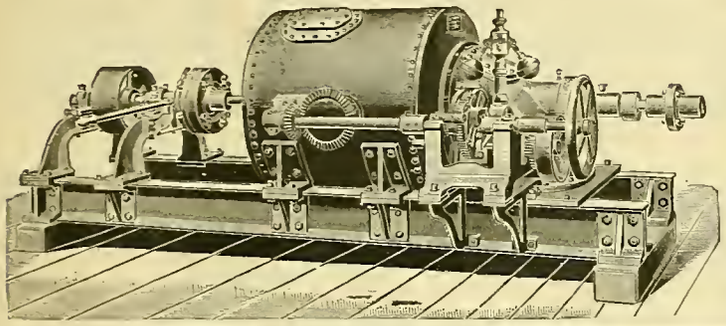

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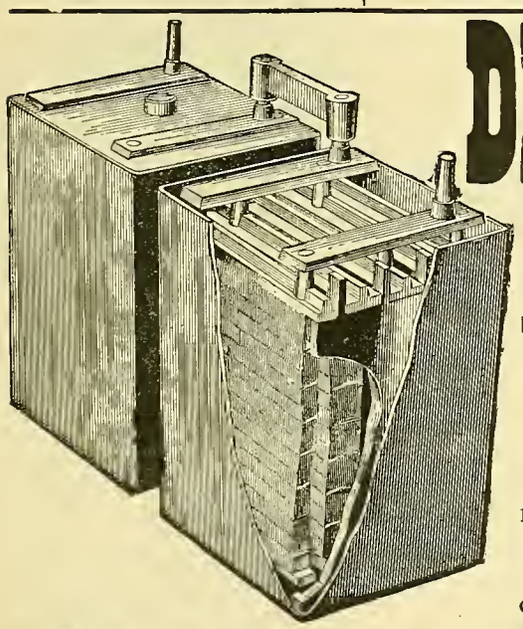

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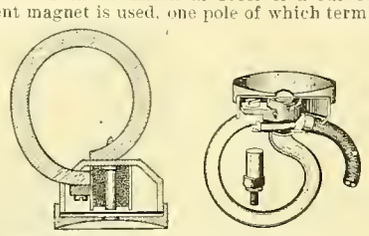
ductor. In the D'Arsonval receiver a curved permanent magnet is used, one pole of which terminates



FIGS. 27 AND 28. D'ARSONVAL RECEIVER.

in a soft iron polepiece that serves as the core of the coil, and the other in an iron box, or cylinder, that

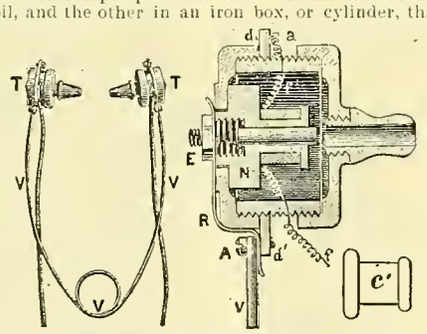



FIG. 29. MERCADIER'S BI-TELEPHONE. *T T* RECEIVERS, *V* SPRING, *N* MAGNET, *E* NUT, *R* STEEL STRIP, *A* SCREW CLAMPING *R* TO *V*, *d d'* METAL COLLAR CLAMPING *V* TO RECEIVER CASE, *f f* TERMINALS OF COIL *a* CONNECTING SCREW, *c'* SOFT RUBBER NIPPLE FOR EARPIECE.

completely encloses the coil. The two poles are magnetically insulated from each other by the wooden case, to the upper part of which the diaphragm is

48 TELEPHONE HAND BOOK.

appeared on the scene with an application for a patent on a microphonic transmitter, and according to the rules of the Patent Office no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbaugh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbaugh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad

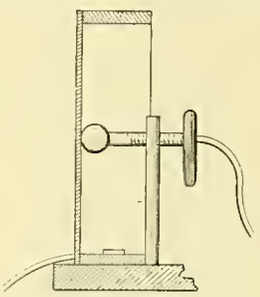


FIG. 44. BERLINER'S FIRST TRANSMITTER.

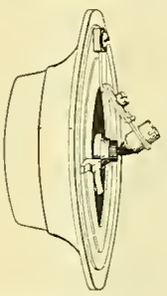


FIG. 45. BERLINER CARBON TRANSMITTER.

principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

78. Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by caus-

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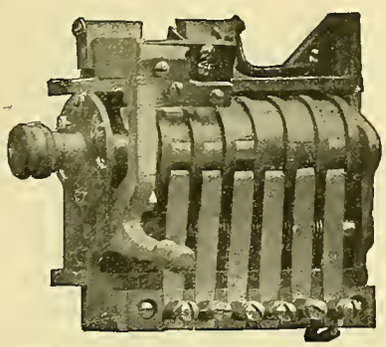

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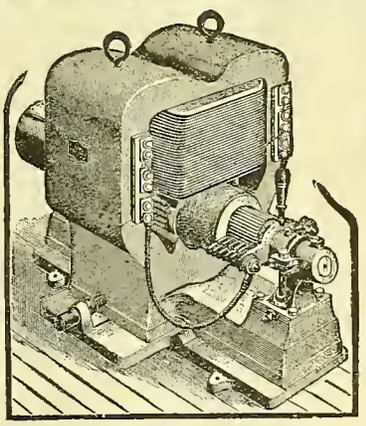

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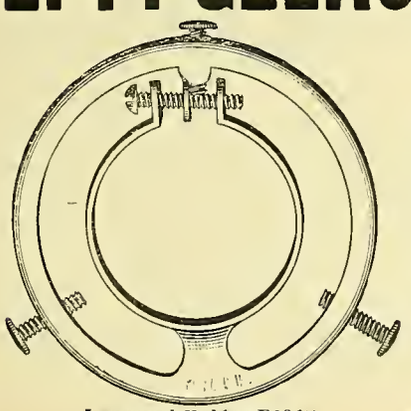

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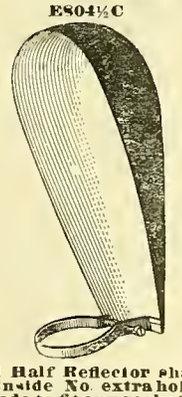

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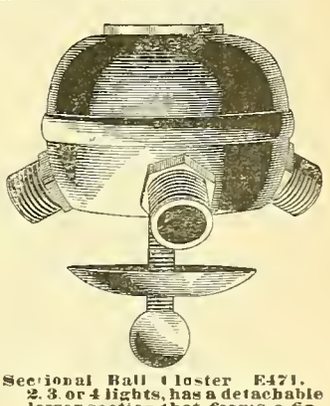

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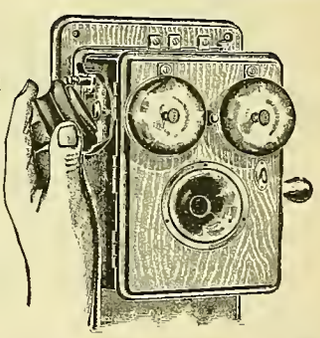

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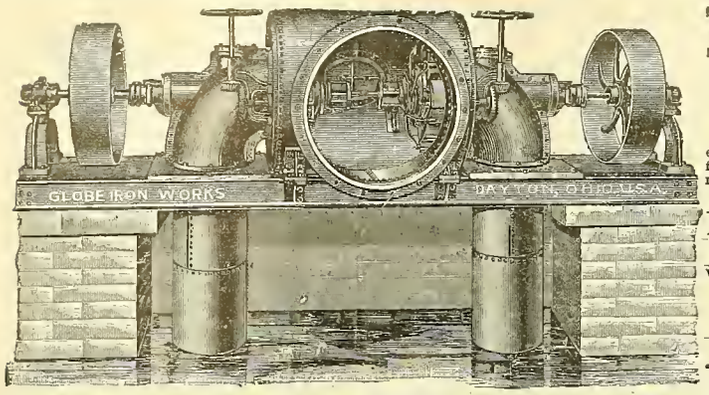


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| ⅞ " | 16.42 | 122.00 | 127.18 | 195.19 | 82.58 |
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|---|---|---|---|---|---|
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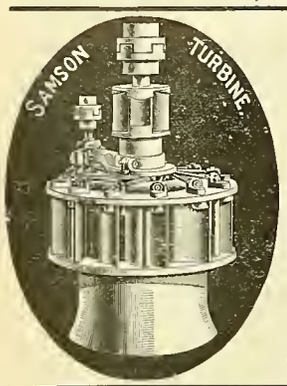


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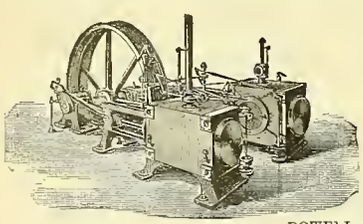

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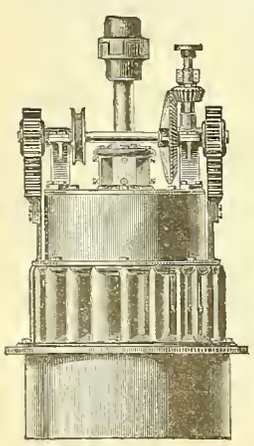

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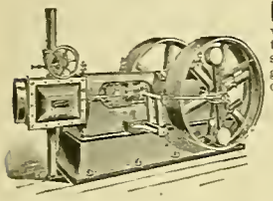

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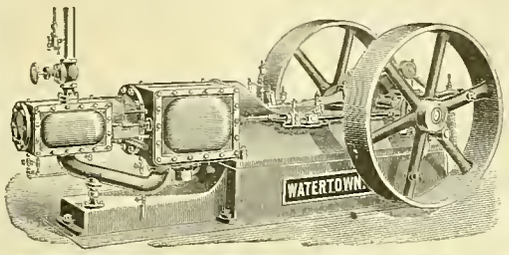


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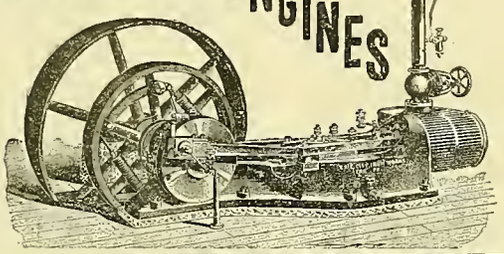

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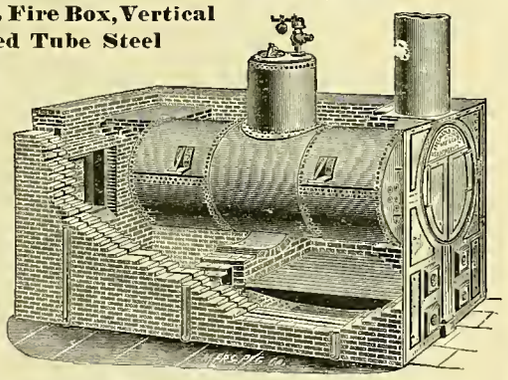

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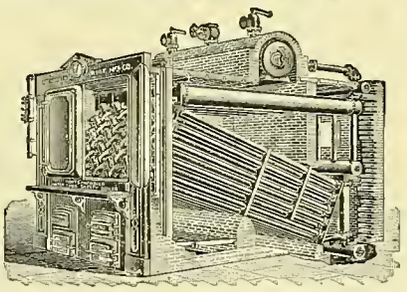

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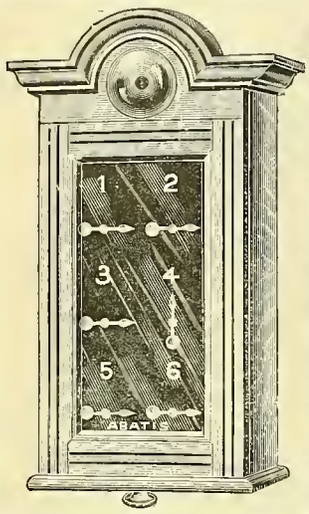

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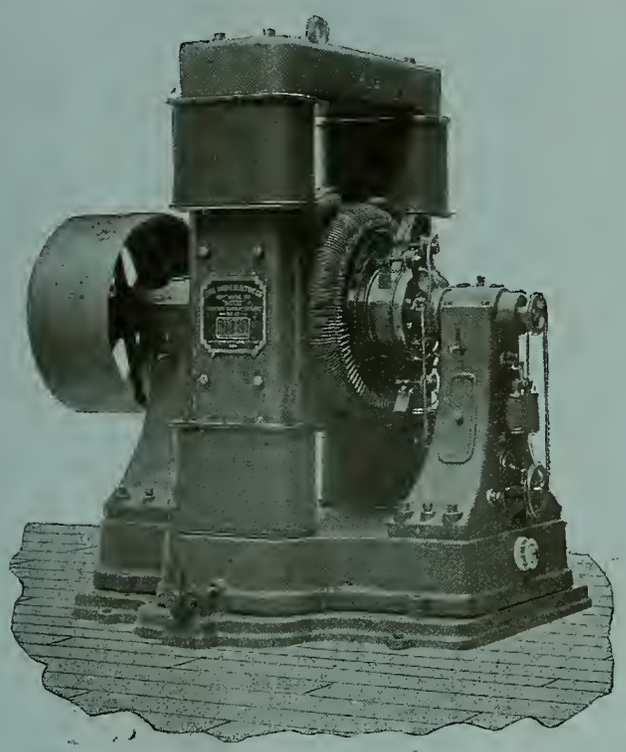

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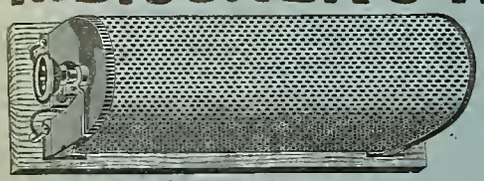

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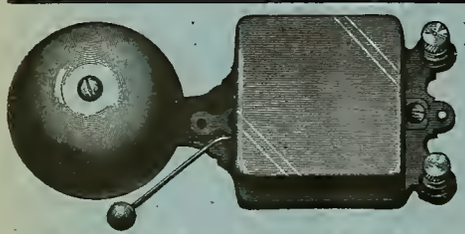

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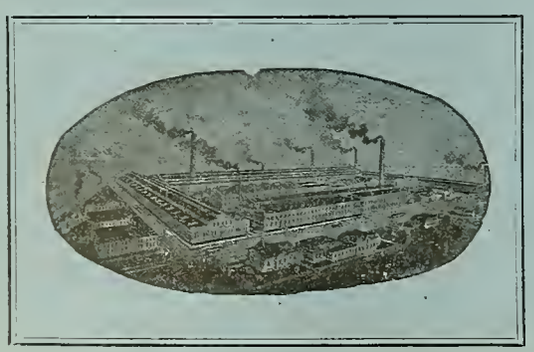

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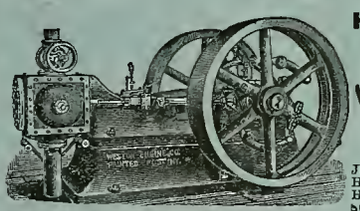

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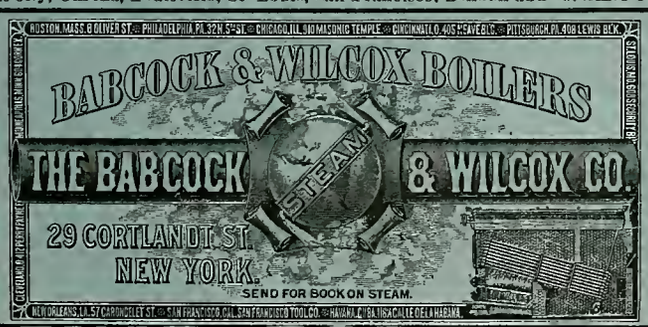


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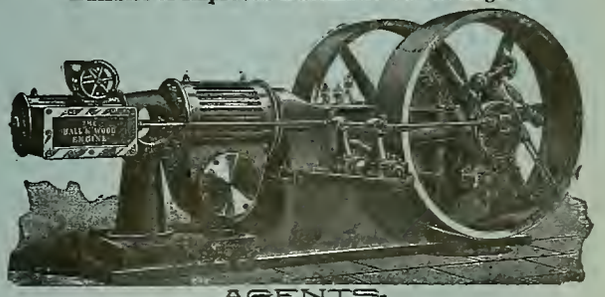

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Central Electric Co.
Interior Conduit & Ins. Co.
Muncie Elec. Mfg Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
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Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co
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Electric Appliance Co.
General Electric Co.
Independent Electric Co.

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Holtzer-Cabot Electric Co.
Partrick & Carter Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Palmer Bros.
Partrick & Carter Co.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

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Phœnix Glass Co.

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**Induction Coils.**
Splitdorf, C. F.

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Bernard Co., The E. G.
Bunnell & Co., J. H.
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Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Fiberite Co., The.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
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New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
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Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Large & Twining.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

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Bernstein Electric Co.
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Electric Appliance Co.
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Jennings, A. R.
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La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
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Porter & Buerdorf.
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Electric Appliance Co.
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Barrison Int. Telephone Co.
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Okonite Co., The.
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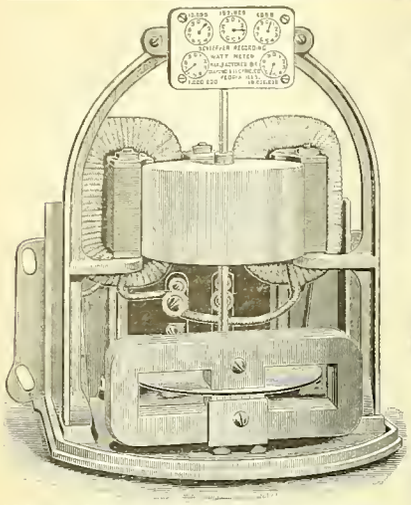

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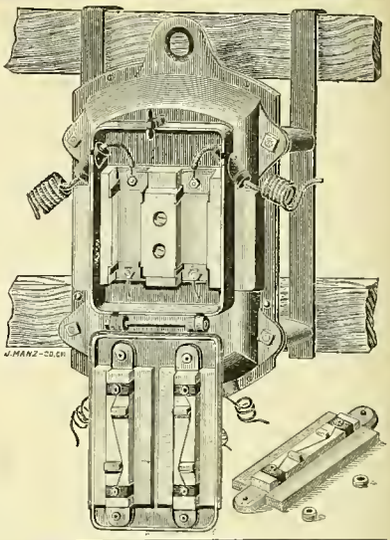
For Alternating Circuits. No Commutator. No Brushes.

Registers Direct Actual Power Consumed.

EASILY ADJUSTED. ABSOLUTELY RELIABLE.



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Simplest, Safest and Best.

FOR ANY VOLTAGE. FOR ALL SYSTEMS.

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# A BRAND NEW ARC LAMP.

# THE A.-W. ARC LAMP.

That burns on any current.

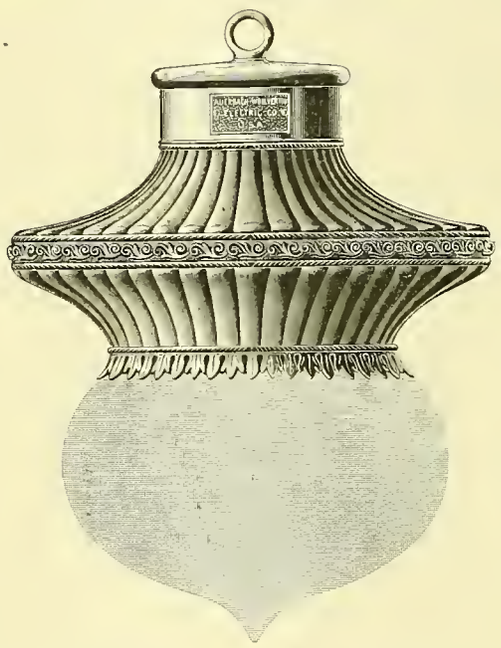
That measures 18 inches from top to bottom (including globe).

That has a life of 25 hours in the open air.

That throws light where you want it—on the ground.

That feeds neither by rack, clutch, clockwork, nor chain.

That casts no shadow whatever.



That gives the maximum light distribution.

That gives an absolutely steady light.

That keeps the arc stationary.

That feeds independent of the magnet.

**SIMPLICITY AND DURABILITY OF CONSTRUCTION.**

**THE MOST ORNAMENTAL LAMP IN THE MARKET.**

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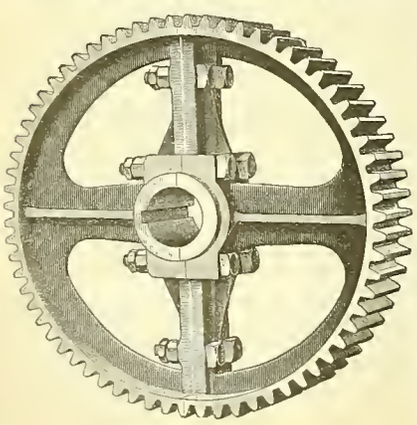

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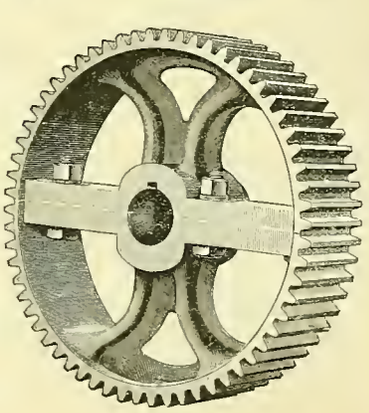
## Electric Railway Supplies.

GEARS, PINIONS, BEARINGS, TROLLEYS, TROLLEY WHEELS AND HARPS.

THIS IS THE IMPROVED NUTTALL TROLLEY.

TRY IT ONCE, AND YOU WILL WANT NO OTHER.



**The largest and most prosperous street railway companies in the country are using our supplies, and they prefer them to all others on account of greater strength and durability. Correspondence solicited.**

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A DAINTY DELEGATE FROM THE

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"I. P. TYPE."

The facility with which any plate can be removed and replaced without interfering in the least with the operation of the battery in supplying electricity, storing surplus power or steadying the current, makes this the only type which meets all the requirements of central stations for light and power, and which enables the owner to maintain his battery at the highest pitch of efficiency.

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## Specially Designed Types.

Accumulators for Street Cars,
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Accumulators Electro-Plating,
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Accumulators Safety Lamps,
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Accumulators for **YOU,**
Correspond with **US.**

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**224 Chestnut Street,**

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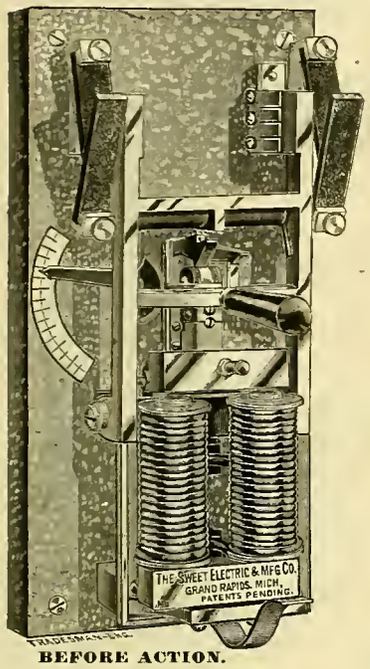

BEFORE ACTION.

Central Stations, Electric Railways, Isolated Lighting and Power Plants

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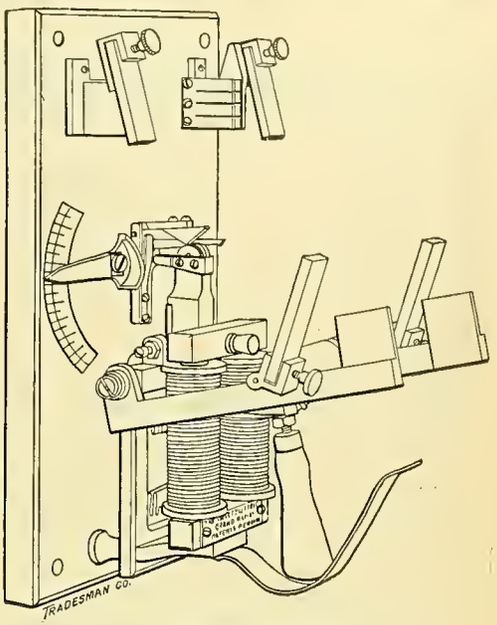
**DO YOU KNOW ITS USE AND VALUE?**



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You insure your building, why not insure your machine? Write to

**THE SWEET ELECTRIC & MFG. CO., GRAND RAPIDS, MICHIGAN,**

AND YOU'LL LEARN THE COST.

# Power Transmission

**And Distribution by Electricity made Practical and Commercial, and Central Station Equipment of largely increased earning capacity available by the**

## Stanley Two-Phase System of Alternating Current Apparatus.

**The Generator has no moving wire, and excels all others in simplicity, Efficiency and Regulation.**

**Motors are self-starting, and take current in proportion to their load, substantially as do direct current motors.**

**Transformers insure satisfactory service and the greatest economy.**

**It is the only complete and perfected system by which Light and Power can be supplied from the same generator and circuit.**

**WE ARE PREPARED TO FILL ALL ORDERS PROMPTLY AND CARRY A FULL STOCK OF TRANSFORMERS IN CHICAGO.**

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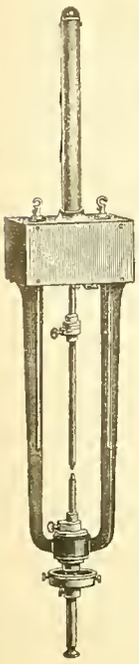


# STANDARD "WARD" LAMPS

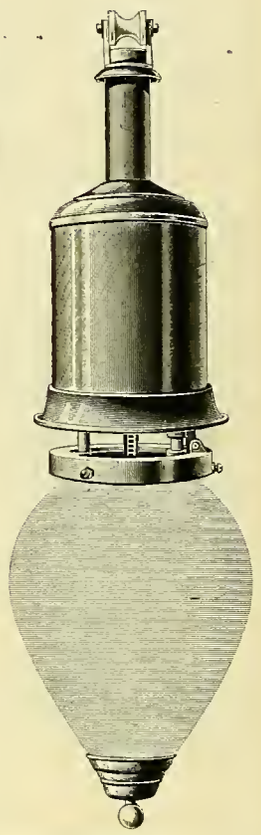
For Direct Current, 110 Volts.

## TEN DOLLARS EACH

**With Globe and Resistance, $2.00 Extra.**

There are more lamps of the above type in use in the United States on Incandescent Circuits, than all other makes combined.

## Send in Your Orders Quickly!



### ALTERNATING LAMPS.

Our new Alternating Lamp is the most economical and surest feed lamp on the market, burning from secondary circuits of 33, 50 or 100 volts.

Simplicity and strength of construction are the strong points of our lamps, rendering them more durable and easier to maintain than any others.

Lamps ENTIRELY WATERPROOF, dispensing with the use of hoods.

Write us for description and circular.

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**Established 1881.** **18 Cortlandt Street, New York.**

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# We Want Western Business.

## LA ROCHE ALTERNATORS.

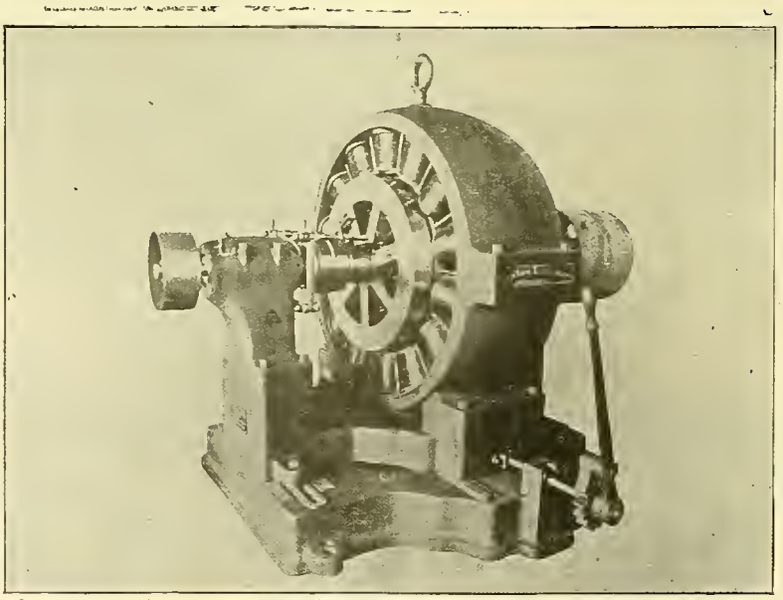
Manufactured in Sizes from

**25 to 5,000 Lights,**

**SINGLE**
OR
**MULTIPHASE.**

Direct Connected Dynamos.

Direct Current Generators.



1,000 Light Alternator.

**LA ROCHE ELECTRIC WORKS,**

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DISTRICT OFFICES:

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The Chloride Electrical Storage Syndicate, Limited, Manchester, England.

Societe Anonyme Pour le Travail Electrique des Metaux, Paris, France.

# The Only Storage Battery in Use in Central Stations, of American Manufacture.

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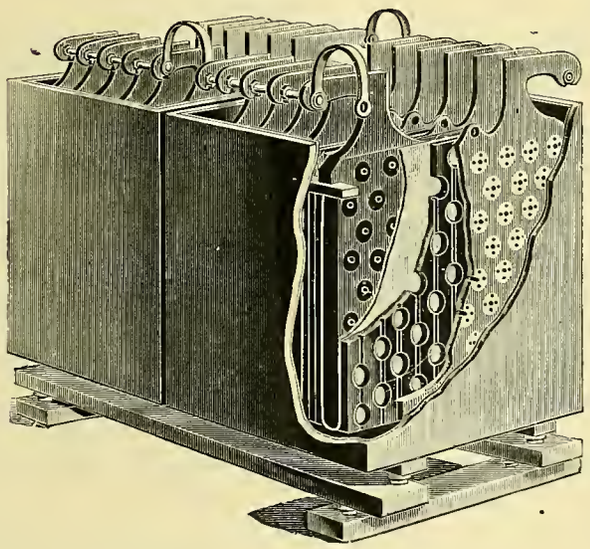
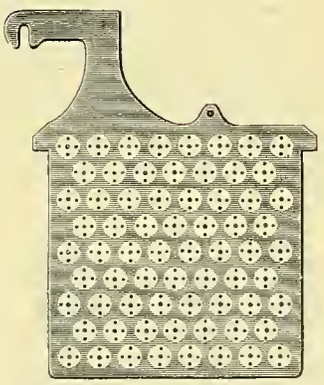
# The Electric Storage Battery Co.,

## DREXEL BUILDING, PHILADELPHIA, PA.





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Registered September 11th, 1894.

## Electrical Storage Cells of any Desired Capacity.

CATALOGUES GIVING CAPACITIES, DIMENSIONS, WEIGHTS, PRICES, ETC., ON APPLICATION.

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ELECTRIC LIGHT and RAILWAY PIPE POLES A SPECIALTY.

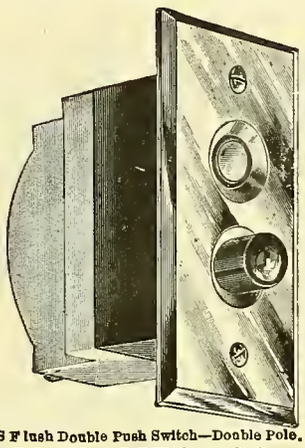
**C-S SPECIALTIES.**

C-S Flush Double Push Switch.
Single Pole—Double Pole—Commutation; 3 Wire, 4 Wire.

C-S Flush Key Switch.
Single Pole—Double Pole—3 Wire.

C-S Flush Automatic Switch.
Single Pole.

ELECTRICALLY MECHANICALLY ARTISTICALLY **PEERLESS.**



C-S Flush Double Push Switch—Double Pole.

**THE CUTTER ELECTRICAL & MFG. CO.,**
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**STREET RAILWAY HAND-BOOK.**

Indispensible to every Street Railway Employe.

**STREET RAILWAYS;**

Their Construction, Operation and Maintenance.

PROFUSELY ILLUSTRATED. Price, $4.00

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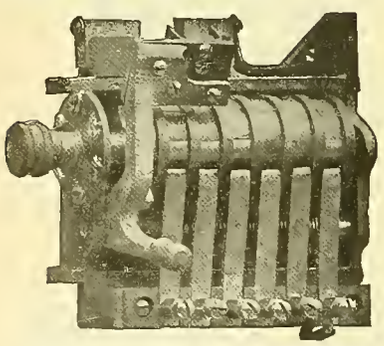


**Electric Car-Heating.**

Regulating Switch Gives

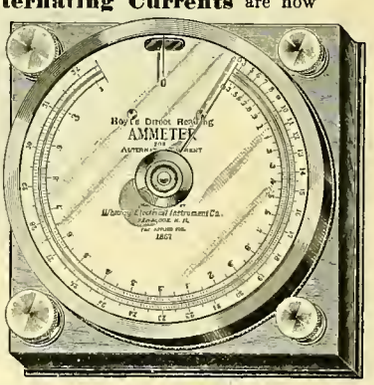
FIVE DIFFERENT INTENSITIES OF HEAT.

In Practical Operation in More Than 25 Leading Cities in U. S. and Canada.

**Something New.**

The **Hoyt Standard Ammeters** and **Voltmeters** for **Lamp** and **Meter** measurement on **Alternating Currents** are now ready for the market.

Send for our **1894 Catalogue** which contains the above and other new instruments of our manufacture.




**Whitney Electrical Instrument Co.,**

PENACOOK, N. H.

Factories: Penacook, N. H.; Sherbrooke, P. Q., Can.

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**WESTINGHOUSE ELECTRIC & MANUFACTURING CO.,**

PITTSBURGH, PA.

We manufacture Complete Installations of

**ELECTRICAL APPARATUS**

For CENTRAL STATION ELECTRIC LIGHTING,
LONG DISTANCE TRANSMISSION OF POWER,
ELECTRIC RAILWAY AND ISOLATED PLANTS.

BRANCH OFFICES IN ALL LARGE CITIES.

# "The Electra"
# CARBONS.

A highly EFFICIENT and ECONOMICAL Arc Light Service depends on the quality of the Carbons.

**THE BEST QUALITY IS THE CHEAPEST.**

## High Grade Nuernberg Carbons

For direct and alternatinng current Arc Lamps, are the most economical and efficient manufactured. They produce a very brilliant and absolutely steady light.

ELECTRA ·TRADE MARK·

Highest Award at the World's Columbian Exposition, Chicago, 1893.

ELECTRA ·TRADE MARK·

Highest Award at the World's Columbian Exposition, Chicago, 1893.

SEND FOR NEW PRICE LISTS AND SAMPLES TO

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Sole Importer for the United States, Canada, Etc.

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Clark Wire, Wagner Converters,
Western Lamps, Iona Switches,
Puritan Sockets, Infinity Dry Batteries,
And a General Line of Supplies

# AT BOTTOM PRICES.

## WESTERN ELECTRICAL SUPPLY CO.,

911-913 Olive Street. ST. LOUIS, MO.

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## CONTROLLER PARTS.

We are prepared to furnish these for the Westinghouse and General Electric Company's Controllers.

Also Vulcabeston Field Magnet Spools, Brushholder Bushings, Commutator Rings and Pieces for special purposes. Owing to its toughness and heat resisting qualities, Vulcabeston is the most practical material for the above purposes.

## Trolley Line Materials,

Insulated with Moulded Mica. Acknowledged as the **Standard** for all practical requirements.

## H. W. JOHNS MFG. CO.,

New York. Philadelphia. Boston. 240 and 242 Randolph St., CHICAGO, ILL.

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## THE ALTERNATING CURRENT MOTOR PROBLEM SOLVED.

# THE MONOCYCLIC SYSTEM,

## A Complete Central Station System for Simultaneous Light and Power.

***Incandescent Lamps, Arc Lamps and Motors Operated from the same Generator Economically and Efficiently.***

**CHARACTERISTICS OF THE MONOCYCLIC SYSTEM:**

*It operates Lights* and *Motors*, in parallel, *on the same generator and even the same transformer.*

*It solves the hitherto unsolved problem of the alternating current motor.* By the use of this system, alternating current motors may be operated which are not only *equal, but superior* to continuous current motors. They have a *constant speed*, are *extremely simple* and *absolutely reliable;* and have neither *commutator, collector rings, brushes nor moving wires.*

*Low tension underground networks* may be operated on the *Edison three wire system* and the *largest part of copper expended in feeders saved*, as it is possible to use *high tension feeders and transformers. A better balance* is secured and the *network may be extended unlimitedly.*

It is as *simple* as the *ordinary well-known alternating system.* It differs from it only in its ability to *operate high grade motors* by means of a **THIRD OR POWER WIRE** which is carried only to the motors and resembles the *neutral wire* of the *Edison three wire system.*

It allows *perfect operation* of the *whole system* of generators in parallel and thereby enables the *whole lighting and power station* to be operated from *three bus-bars only, the third intermediate bus-bar being for motor supply.*

It will operate, by the use of *two transformers, three phase, quarter phase or any other type of alternating current motors.*

It gives a *perfect regulation of the whole system,* as all difficulties caused by *self induction or capacity* are eliminated. Current may be transmitted over any distance, in consequence of its low frequency—7,200 alternate.

It is operated with *generators* and *transformers* of an hitherto unattained *efficiency* and *regulation.*

*The generators and motors are both slow speed.*

---

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PRINCIPAL SALES OFFICES.

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Pittsburg, Pa., 425 Wood Street.
Baltimore, Md., 227 East German Street.

Atlanta, Ga., Equitable Building.
Cincinnati, Ohio, 264 W. Fourth Street.
Cleveland, Ohio, 510 Cuyahoga Building.
Detroit, Mich., 13 Rowland Street.
Chicago, Ill., Monadnock Building.
Omaha, Neb., 309 South Street.
Kansas City Mo., New York Life Building.

St. Louis, Mo., Wainwright Building.
Dallas, Texas, Corner Field and Main Streets.
Denver, Colo., Masonic Temple.
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**For all business outside the United States and Canada—Foreign Department, Schenectady, N. Y., and 44 Broad Street, New York.**
**For Canada—Canadian General Electric Co., Ltd., Toronto, Canada.**

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## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

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Works: GARWOOD, N. J.
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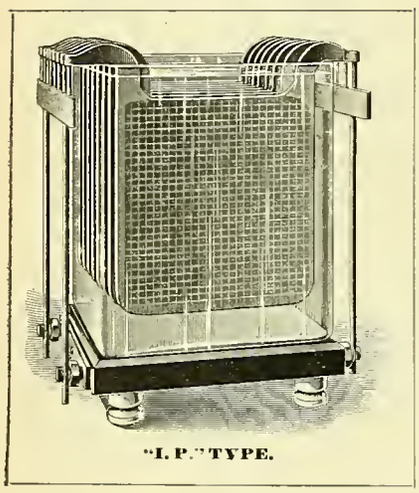
BRANCH OFFICES: CHICAGO, 1020 and 1021 Monadnock Building. BOSTON, 63 Oliver St.
CLEVELAND, Cuyahoga Building. PHILADELPHIA, 633 Arch St.

# Accumulator Company.



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FOR
## CENTRAL STATIONS
SUPPLYING
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New Type with Independent Plates which can be Easily Examined and Replaced without interfering with Charge or Discharge. Capacity from 350 to 12,000 Ampere Hours. No Nuts, Bolts or Screws. Meets all Requirements of Central Stations.

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*ELECTRO-PLATING,*
*ELECTRIC WELDING,*
*CAUTERY BATTERIES,*
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MARO S. CHAPMAN, Pres. THOMAS C. PERKINS, Vice-Pres. JOHN L. BUNCE, Sec'y and Treas. TH. GONET, Supt.

# THE MATHER ELECTRIC COMPANY,
## Manchester, Conn.

**Power Generators for Lighting and Railway Purposes.**
**Complete Station Equipments.**

Mather Apparatus for sale exclusively in their respective territories by the following well-known and reliable Contractors:

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H. B. COHO & CO, 203 Broadway, New York: New York City, Brooklyn and vicinity and New Jersey.
G. M. ANGIER & CO., 116 Bedford St., Boston, Mass.: New England.
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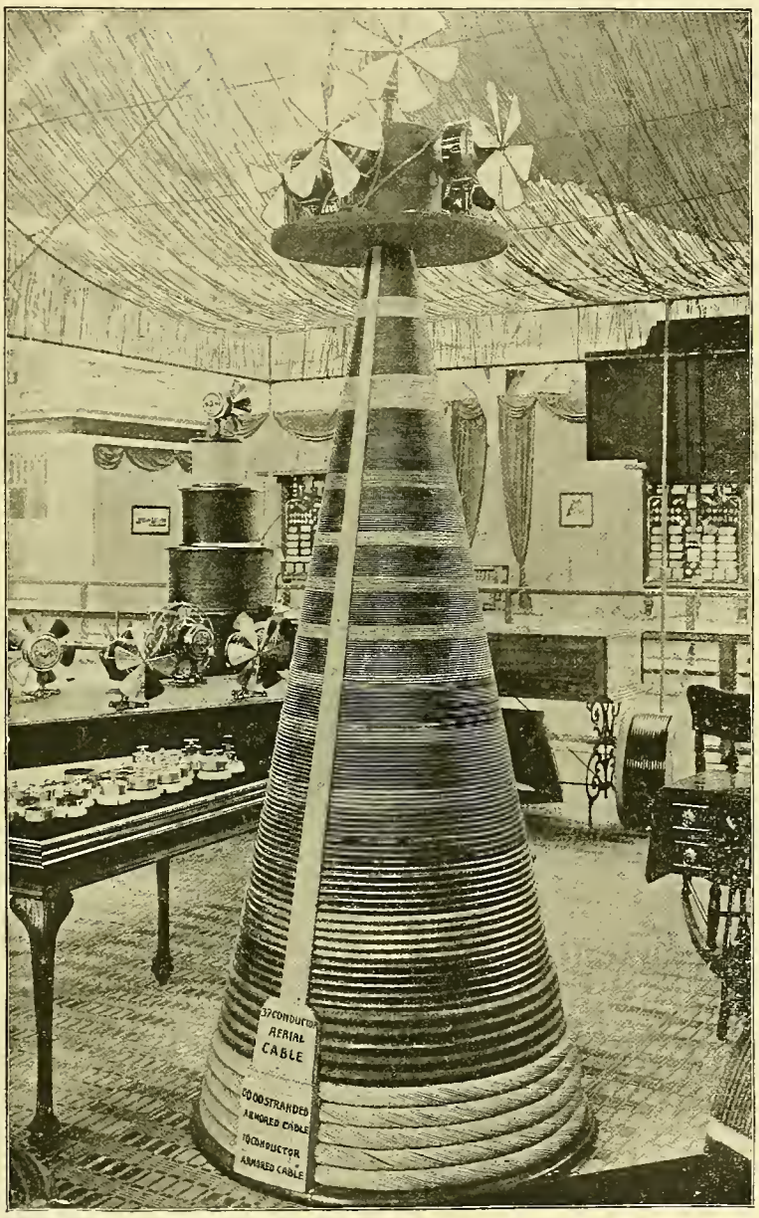


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**PARANITE** Always Firmly Standing. Always Pointng Upwards.

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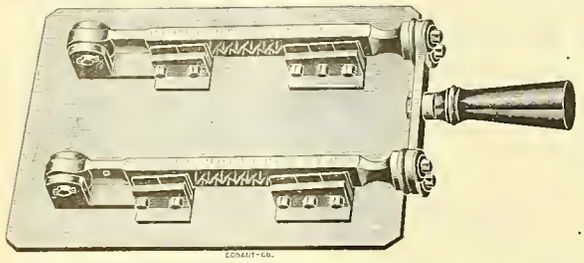
# ELECTRIC APPLIANCE COMPANY,

*GENERAL WESTERN AGENTS,*

ELECTRICAL SUPPLIES. 242 Madison Street, Chicago.

# W. S. HILL ELECTRIC CO.



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The strongest castings made. The wrought iron castings are very desirable for electrical purposes.

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The Only Clocks Used in the W. U. Tel. Co. Time Service.

NO WINDING. CORRECTED HOURLY.

SELF-WINDING CLOCK CO.,
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*Clocks Sold. Clocks Rented.*

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Send for Samples and Prices.

**Samson Spot Cord.**

For Arc Light and Trolley Cord.
SAMSON CORDAGE WORKS, BOSTON, MASS.

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## Subscribe for the Western Electrician.

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# WIRT INDICATORS.

Direct and Alternating. For Switchboard Work.
Direct Reading. Amperes up to 1,000. Volts up to 3,000.
Accurate, Reliable, Unchangeable, Handsome.

Write for quotations to your dealer, or to

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For all Purposes.

Scrap and Native Platinum Purchased.

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*CATALOGUES AND QUOTATIONS ON APPLICATION.*

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# THE LATEST IN ELECTRIC Soldering Irons.

Write for Circulars descriptive of

NEW ELECTRIC HEATING DEVICES.

## American Electrical Heater Co.,

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# The BISHOP GUTTA-PERCHA CO.

THE BEST GRADES OF

## Wire and Cables

For under ground, under water, and all other conditions.

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## For Electrical Purposes

Guaranteed 98/99% and free of lead and iron. If you want the best quality ask your dealer for this brand. Imported by

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CLEVELAND, 24 South Water Street.
CHICAGO, 185 to 189 Van Buren St.
ST. LOUIS, Eighth and St. Charles St.

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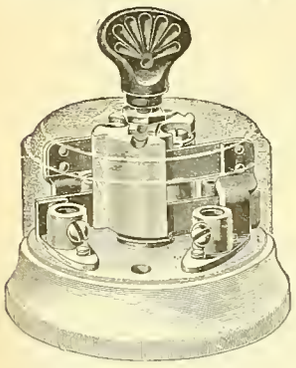

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# The Harrison International Telephone Co.

AGENTS' TERRITORIES NOW BEING ALLOTTED.

WRITE AT ONCE.

WHAT MONEY CAN EARN AND THE PEOPLE SAVE BY MEANS OF THE

## Harrison International Telephone.

**We either sell our telephones outright or lease them for a term of years.**

This company owns Letters Patent No. 476,200, granted to E. M. Harrison May 30, 1892, and Letters Patent No. 499,108, granted to E. M. Harrison June 6, 1890, for a complete electric speaking telephone operated by battery; and owns Letters Patent No. 435,295, granted to William Hutson Ford August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

Prospectuses furnished by addressing the Company at their offices,

Offices, Chamber of Commerce Bldg., Chicago.

woodwork is of polished mahogany, and the upholstering of peacock blue brocaded plush. There are 20 armchairs. The doors are double, acting in concert, and give sufficient space when opened to admit of a lady in full evening dress passing in and out without danger to her costume.

Treasurer Kobbe of the Westinghouse Electric company was in Boston recently in conference with the company's Boston directors. The Newark, N. J., factory, he says, will be removed to the new works at Brinton immediately.

A trolley railroad is proposed to run from the Merrimac valley in Massachusetts, through the White Mountain resorts of New Hampshire, to the St. Lawrence river.

A new telephone line is being strung between Westbrook and Gorham, Me.

The Union street exchange of the Providence, R. I., Telephone company will soon be completed.

A new electric street railway has been successfully opened between Athol and Orange, Mass.

Work on the new Hampden and Winterport, Me., electric road will begin as soon as the frost is out of the ground in the spring.

The state Legislature of Vermont, when it meets this month, will probably be asked to grant a special charter for an electric railway from Bennington to the New York state line, connecting with the Hoosick railway. J. C. E.

## PERSONAL.

Secretary M. A. Bird of the Wallace Electric company, Chicago, will attend the convention at Atlanta, Ga.

George A. McKinlock, president of the Central Electric company, Chicago, has returned to the city after an absence of some time.

A. B. Field of the Ionia Manufacturing company, Boston, Mass., was in Chicago last week looking over the western field in the interest of this company.

Friends of F. S. Kenfield, business manager of the *Street Railway Review*, Chicago, will be pleased to learn that invitations have been issued for his marriage on Wednesday evening, October 24th, to Miss Amy Sweeney of Rock Island, Ill. Mr. Kenfield has been confined to his room for some days past with a slight illness, but from the fact that the wedding invitations have been issued it is presumed that his indisposition is slight, and it is hoped by his many friends that it will not interfere with the happy event. Mr. Kenfield's many friends in the newspaper business and among the street railway men extend hearty congratulations, in which the WESTERN ELECTRICIAN joins.

## ELECTRIC LIGHTING.

San Francisco, Cal., will purchase a new engine, dynamo, etc., for enlarging an electric light plant.

Colton, Cal., will have a municipal electric light plant soon. The mayor has the matter in charge.

The question of a municipal electric light plant is to be discussed at the next meeting of the city council of Spokane, Wash.

Waukon, Ia., has granted an electric light franchise to Judge Hendrick, who proposes to commence the work of construction immediately.

Work will be commenced on the electric light plant to be constructed by Iowa Falls, Ia., shortly. The city clerk will furnish further particulars.

At a recent meeting of the board of trustees of Val'ejo, Cal., it was decided to establish a municipal electric light plant, and proposals are now invited for the lighting of the streets. The old electric light plant was destroyed by fire some weeks ago. The city clerk can furnish particulars.

## ELECTRIC RAILWAYS.

An electric road is to be built from Nevada City to Grass Valley, in California.

The Joplin, Mo., Electric Railway company proposes an extension of its line to Galena, Kas., a distance of eight miles.

Iowa City, Ia., is making an effort to get an electric street railway, and will secure it if $8,000 can be raised to unite with outside capital.

The charter for a new electric street railway was filed in Scranton, Pa., last month. It will run from Nanticoke to Aldin, thence to Wanamie and Glen Lyon. The incorporators are all Nanticoke men. The capital stock is $60,000.

## MISCELLANEOUS.

The annual meeting of the Cleveland Electrical club was held October 3d. The following named officers were elected: President, C. W. Wason; first vice-president, B. M. Barr; second vice-president, T. E. Adams; secretary, H. D. Davis; treasurer, E. W. Moore; board of managers, R. M. Fuller and George W. Cleveland.

## TRADE NEWS.

The Washington Electric company, Chicago, reports that it has installed a large number of the well-known Meissner stage regulators in various theaters throughout the country within the last few months.

The Wallace Electric company, Chicago, has issued a catalogue of electrical railway supplies that should be of interest to all electric railway men. This book shows the company's stock to be complete and to comprise a number of well-known articles of recognized merit.

The Mather Electric company of Manchester, Conn., reports the closing of a second contract with the Hartford & West Hartford Horse Railway company, Hartford, Conn., for two of its 180 kilowatt railway generators with new Mather station equipment, the first generator, which was installed a few weeks ago, having given perfect satisfaction.

The Electric Appliance company, Chicago, reports having secured the western agency for the well-known line of electric railway supplies of the Lynn Manufacturing company, and that it will carry a large stock in Chicago and be prepared to ship entire equipments from that point. Special catalogues and advertising matter are being prepared by the company, and will be ready for distribution shortly. In the meantime the Electric Appliance company will be pleased to hear from the electric railway trade, and desires opportunities to make prices on material for electric railway equipments. The Appliance company intends to make attractive prices on the high grade Lynn material, which includes one of the best railway insulations ever produced.

## BUSINESS.

The W. S. Hill Electric company reports business as good in all its lines, but especially brisk in switchboards, some particularly large and fine ones having recently been turned out.

The Metropolitan Electric company, Chicago, received an order last week for sixty-five miles of I. X. L. weather-proof wire from a customer who has already had fifty miles in use. This speaks well for this well-known insulation.

The organization of the Louisville Electrical Works at Louisville, Ky., is reported. The concern will manufacture electrical and mechanical specialties and repair electrical machinery and apparatus. It will be located at 148 Fifth street. The general manager is Campbell Scott.

The largest line of pattern letters to put on patterns for castings is made by H. W. Knight & Son, Seneca Falls, N. Y. They are constantly adding new styles and sizes and are abreast of the times in variety and prices. They have recently made shipments to Turkey and have an increasing trade in other foreign countries as well as in the United States. Try them with your next order, addressing Drawer 1256.

The Cortland & Homer Traction company has just closed the contract for the equipment for its entire steam plant. The specifications were drawn and contracts placed under the direction of Prof. R. C. Carpenter of Cornell University. The company will put in four compound condensing Watertown engines with pumps, condensers, heaters and four 100 horse power boilers manufactured by the Watertown Steam Engine company of Watertown, N. Y.

The Link Belt Machinery company, Chicago, reports the following recent sales of the standard water tube safety boilers: Plainwell Church Furniture company, Plainwell, Mich., 100 horse power; Mutual Electric Light & Power company, Chicago, 600 horse power; Pittsburg High School, Pittsburg, Pa., 250 horse power; Institute for the Feeble Minded, Pittsburg, Pa., 800 horse power, and Detroit Chamber of Commerce, Detroit, Mich., 300 horse power.

The Independent Electric company, Chicago, is headquarters in the West for slate for electrical purposes. All shapes and styles of finish are furnished on short notice. The company handles exclusively Vermont slate, which is known to be of the best quality. The Independent company has an elegant line of samples at its office at Thirty-ninth street and Stewart avenue, which it is pleased to show. The company reports business in this line to be improving.

The Central Electric company, Chicago, after having made exhaustive and careful tests of the B. & S. compounds and paints, will handle this product in the West, as general western agents. The company reports that it finds that the B. & S. products are among the highest insulating mediums of their kind on the market, and states that it will carry a large stock in its Chicago warehouse. The company has already secured sufficient orders to prove that the trade appreciates the superiority of this product.

The Mather Electric company of Manchester, Conn., reports the following recent sales in its isolated lighting department: North Packing & Provision company, Somerville, Mass., one 100 light dynamo; Hermann Ankam & Co., Lebanon, Pa., one 600 light dynamo; Church Green Electric Light & Power company, Boston, Mass., one 600 light dynamo; Iowa School for the Deaf, Council Bluffs, Ia., one 600 light dynamo; Connecticut River Paper company, Holyoke, Mass., one 700 light dynamo and two 15 horse power Manchester motors; Henry R. Worthington, Hydraulic Works, Brooklyn, N.Y., one 600 light dynamo, one 10 horse power motor and one 45 horse power 220 volt generator; the J. B. Williams company, Glastonbury, Conn., one 150 light dynamo; Graif Bros., Lake Crystal, Minn., one 150 light dynamo; Ohio State University, Columbus, O., one 13 horse power Manchester motor; Grenada Hotel, Chicago, Ill., one 450 light dynamo; Barney & Smith Manufacturing company, Dayton, O., one 3 horse power Manchester motor; B. T. Sturtevant & Co., Chicago, Ill., one 10 horse power Manchester motor; G. M. Angier & Co., Boston, Mass., one 100 light dynamo; Candee company, New Haven, Conn., one 50 light dynamo; Moorehouse Bros., Chanterice, Conn., one 50 light dynamo; Odd Fellows Hall, Philadelphia, Pa, one 30 kilowatt, one 50 kilowatt and one 80 kilowatt directly connected generator and 50 horse power in motors; S. N. Blake, Elmira, N. Y., one 350 light dynamo; Nardi, Strang & Co., Philadelphia, Pa., one 50 light dynamo; George W. Furbeck, Chicago, Ill., one 250 light dynamo; C. B. Boothe, Los Angeles, Cal., two 5 horse power and one 3 horse power Manchester motors; Badger Lumber company, Kansas City, Mo., one 100 light dynamo; Leafe Bros., Winchester, Va., one 50 light dynamo; Stanley Laboratory company, Pittsfield, Mass., one 10 kilowatt exciter; Diamond Machine company, Providence, R. I., one 300 light dynamo and West Virginia Improvement company, Pocahontas, W. Va., one 60 kilowatt 220 volt generator.

The exhibit of the General Electric company at the Atlanta convention will be of an elaborate nature. It will comprise motors, controller, other car equipment parts, station switchboard panels, line material, wattmeters, etc. The G. E. 800 motors will be shown not only in the exhibit proper, but, mounted on cars, will operate them over the lines of the Atlanta Street Railway company. Ample opportunity will be afforded for a close and critical examination of these motors and of the component parts which enter into their construction. The motors shown in operation will act in conjunction with the "K" controller, and those interested will be enabled to investigate the merits of the combination. The principle of the magnetic blowout device will also be shown and explained and its action demonstrated. This principle is embodied in all other devices in which electric arcs may occur, such as switches, fuses, lightning arresters, etc. Several sizes of generator and feeder panels for station switchboards, all of black marbleized slate with the necessary instruments mounted thereon, will also be shown. These panel boards are made in various capacities to suit the requirements of the plant, and have been devised so that the switchboards may be increased in size as the station grows merely by the addition of other panels. The line material exhibited will embody several improvements of an important character, which have become necessary by the increased demands of railroad service. The Thomson Recording wattmeter in its portable form for testing on moving cars will also form an important item of the exhibit, which will be illuminated by means of Thomson '93 arc lamps for railway circuits, connected in series and operating on the railway lines. They have been especially designed for use in power houses, car barns and elsewhere where light is desired from 500 volt circuit. The exhibit will also comprise samples of underground feeder tubing with models of junction boxes and taps, and among the literature which will be distributed will be found a special pamphlet dealing with the application of the three wire system to street railway work. The interests of the General Electric company will be in charge of W. J. Clark, general manager of the railway department. He will be assisted by W. H. Knight, chief engineer of the railway department, Theo. P. Bailey, H. H. Corson, H. J. Crowley, W. B. Potter, H. C. Wirt and A. K. Baylor. Visitors to the convention will find a warm welcome at the Atlanta office of the company and, indeed, anywhere where the General Electric company's representatives may be found.

# ILLUSTRATED ELECTRICAL PATENT RECORD.

*Issued October 9, 1894.*

527,066. Device for Protecting Separately Excited Generators. Benjamin G. Lamme, Pittsburg, Pa. Application filed February 28, 1894.

The invention contemplates bringing the circuit of the field magnet and its exciter to a break, so that when the armature circuit is broken in the main generator the field magnet circuit is also broken. Thus two counteracting magnetisms are simultaneously developed. The two circuits will not interfere with each other, as the difference of potential between the two binding blocks at the break is normally zero. When, however, the break occurs under the action of the solenoid employed, the armature tends to drive current back through its field magnet. If the normal magnetization, therefore, be due to a current opposite in direction to the tendency of the armature, and the break be made, the armature will kill the magnetism of its own field magnet, and the generator will be immediately rendered harmless.

527,070. Electrical Converter. James W. Packard, Warren, O. Application filed January 3, 1894.

The invention consists of a converter having primary and secondary coils of wire and a series of plates encompassing both of the coils, and arranged in such manner that they will fit snugly together and form inner and outer rings presenting even surfaces, the entire series of plates forming a compact, nearly solid mass.

527,071. Electrical Fuse Box. James W. Packard, Warren, O. Application filed January 3, 1894.

The device patented comprises a hollow fuse box and a core of non-conducting material in which contact is maintained by a longitudinal spring pressure. It also comprises a fuse box having electrical connections at its ends, and a central core located in the box and held in fixed contact with the electrical connections. The invention further comprises a fuse box having electrical connections at its ends, a central core of non-conducting material, and a spring pressed longitudinally on the core for holding it securely in position.

527,075. Running Compound Wound Dynamo-electric Machines in Multiple. William B. Potter, Schenectady, N. Y. Application filed June 2, 1894.

This invention relates to running continuous current dynamo-electric machines in multiple, and has for its object to provide a method of starting up one or more machines after the other machines are running, without the difficulty attendant upon this operation in methods ordinarily practiced, and without the danger from excessive sparking and from the great rush of currents caused by ordinary methods.

527,092. Circuit Controller for Regulators. Barton B. Ward, New York, N. Y. Application filed October 13, 1893.

The device consists of a circuit controller in which a movable contact is actuated by a fluid pressure affected device or by a temperature affected device, or by any other automatically operating device, which is retained in engagement with a co-operating contact until a certain pressure is reached, and then instantaneously breaks the engagement.

527,098. Railway Annunciator. Charles R. Alsop, Middletown, Conn. Application filed November 2, 1893.

The main object of the invention is to effect improvements in railway annunciators, whereby the signal or call bell part will continue to be active until the bell circuit is mechanically broken, thereby preventing the possibility of the signal being accidentally unnoticed by the operator.

527,099. Electric Track Signal. Charles R. Alsop, Middletown, Conn. Application filed November 27, 1893.

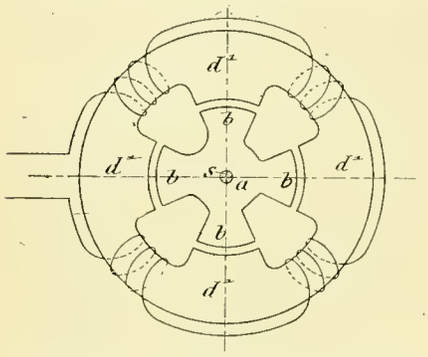
In an electric track signal the combination is described of suitably arranged separated contact springs, a signal circuit having the wires thereof connected separately to the springs, and a horizontal spring actuated contact lever mounted to play on a vertical pivot adjacent to one side of a track rail and normally out of contact therewith to leave a space of a width less than a car wheel flange, which is adapted to move the contact lever laterally between the contact springs.

527,126. Electric Locomotive. Nicolas J. Raffard, Paris, France. Application filed July 23, 1891.

This invention, which comprises improvements on a former patent, relates to an electric locomotive which is moved by one or more electric motors of any type, whose armatures or rotating bobbins are integral with hollow arbors placed concentric with the mean position of the axles. These hollow arbors turn in bearings attached to suspended frames, and transmit the movement to the drive wheels through the intermediation of elastic connections. The electric energy which actuates the electric motor is furnished either by electric batteries or by accumulators carried by the electric locomotive, or by any system of conductors in communication with a distant source of electricity.

527,127. Commutator Brush Holder. George Rauch, Milwaukee, Wis. Application filed April 28, 1894.

Novelty is claimed for an insulating base attachable to a commutator supporting frame, and brush holders connected to the base, each holder comprising a shell provided with a binding post and brush guide, a crank having a flanged arm run through the shell and its other arm loosely engaged with the brush guide, a rotarily adjustable washer on that arm of the crank engaging the shell, and a spiral spring connecting the washer and arm flange.




NO. 527,195.

527,150. Electric Ore Amalgamating Apparatus. John C. Ludwig, San Francisco, Cal. Application filed March 5, 1894.

The novel features of the apparatus comprise a sluice box or trough with a flat bottom and standing sides, a bottom plate of zinc or other suitable metal which is a good conductor, a flexible loosely lying apron or blanket formed of woven or flexible felted fabric capable of absorbing and retaining water upon the plate, and suitable electrical conductors and connecting means by which the plate is connected with one pole of a dynamo-electric machine, or other generator of electricity, and the blanket or apron is similarly connected with the other pole of the generator. Mingled pulp and water is fed in at the upper end of the apparatus upon the zinc plate, the sluice box being suitably inclined from that end downward to give the stream of pulp proper movement or rate of travel between the surface of the zinc and the overlying blanket.

527,177. Electric Switch. Raymond S. Kelsch, Chicago, Ill. Application filed May 28, 1894.

The switch, which is of novel construction, is especially desirable for series systems of arc lighting, and is designed to avoid sparking between contacts.

527,195. Alternating Current Motor. Carl Coerper, Cologne, Germany. Application filed May 15, 1894.

In the accompanying drawing *a* is an armature, which is made of a piece of sheet iron or of a number of sheet iron pieces, which are connected so as to form an armature having radial arms. The armature *a* is mounted on a rotary shaft *s*, which passes through its center. Two adjacent arms *b b* of the armature are always under the influence of opposite and alternating poles of the field magnets *d' d'*. As soon as the armature is rotated at synchronous speed with the generator, it exerts considerable tractive force, and keeps up a speed corresponding exactly with the alternating changes of the current. Four pole faces are formed, and all the radial arms of the armature are simultaneously subjected to the influence of the alternately changing polarities of the pole faces. The form of the armature, as well as the form of the field magnets, has to be adapted for the purposes for which the motor is to be used.

527,211. Electric Arc Lamp. Max Mayer, New York, N. Y. Application filed June 18, 1894.

In this improvement an inverted and suspended base is made use of, to which the upper end of a hanging glass or transparent inclosure is connected substantially air-tight, and the carbons approach each other in the form of an inverted pyramid, and the cores of the regulating magnets preferably pass through the inverted base, so as to act upon the carbon holders in drawing the arc, but the helices of the electro-magnets are above the inverted base, so as to be easy of access, and also removed from the heat of the lamp, and in order to render the inclosure for the lamp substantially air-tight, the cores of the electro magnets slide in tubes that are closed at their upper ends, so as to exclude the atmosphere as well as protect the sliding cores from dust or other foreign substances that might obstruct the action of the electro-magnets.

527,214. Telephone Transmitter. Thomas McCoubray, New York, N. Y. Application filed August 16, 1894.

The invention is directed particularly to improvements in telephonic transmitters of the Hunnings type, in which carbon or equivalent comminuted material is used, and it has for its objects first, the prevention as far as possible of the packing of the powder when in use; second, the accurate adjustment of the parts for the purpose of obtaining the best possible effects.

527,225. Adjuster for Field Magnets of Dynamo-electric Machines or Motors. Montgomery Waddell, Bridgeport, Conn. Application filed September 26, 1893.

The invention relates to dynamo-electric machines and motors, and has for its object to provide a means for adjusting the magnets to compensate for the slight change of position of the armature, due to the wear of the bearings and kindred causes.

527,228. Electric Arc Lamp. John E. Woolverton, New York, N. Y. Application filed February 9, 1894.

The invention is made with reference to avoiding a shadow, and the inventor makes use of four carbons placed at a inclination to each other and coming to a focus or inverted apex, thereby entirely avoiding the casting of a shadow downwardly, and he combines with the carbons, their holders, sockets and lazy tongs, a main electro-magnet and a shunt magnet that act upon one or both pairs of carbons to separate them more or less in drawing the electric arc, one or both bases to which the pairs of carbons are permanently connected being hinged so as to allow for the aforesaid movement being given with but little friction or power in the regulation of the arc.

527,229. Electric Arc Lamp. John E. Woolverton, New York, N. Y. Application filed April 13, 1894.

In the present improvements the carbons are brought together in the form of a pyramid and separated by the action of the current passing through an electro-magnet, and the present invention relates to peculiar features of construction, whereby the lamp is rendered compact and facility given for the insertion of the carbons and for maintaining the proper relative position of such carbons by a simple mechanism that is not liable to become obstructed by friction or the presence of dust or any foreign substances.

527,244. Electric Locomotion on Railways. Jean J. Heilmann, Paris, France. Application filed April 20, 1894.

The object of this invention is to permit the engine to work with a constant cut-off, and consequently always under the most favorable conditions, or in other words so that the work done is always proportional to the speed of the engine, irrespective of the speed of the electro-locomotive and its train. In the accompanying illustration *C* is the generating dynamo and *E* its exciting machine. The current from the exciter passes through the rheostat *R* and the ammeter *a* on its way to the generator field magnet coils. *r* is the regulating rheostat of the exciting machine, *v* the voltmeter of this machine, and *V* the voltmeter of the generating dynamo. *A* is the principal ammeter, and *A'* to *A⁸* ammeters in the separate motor circuits. *I'* to *I⁸* are switches in the separate motor circuits. *C* is a commutator which is arranged to reverse the electro-motors by inverting the connections of the motor magnet coils *b'* to *b⁸* with regard to their armatures *K'* to *K⁸*. When the generating dynamo is employed as a motor to start its driving engine *D* from a dead center, the exciting machine being driven by its separate engine *D'*, the current from the exciter is passed temporarily into the generator armature by means of the switch *I*.

527,254. Insulator. William D. Trimble, Baltimore, Md. Application filed February 2, 1894.

An insulating cleat for suspending electric wires is described, comprising an upper piece, having a socket closed on all vertical sides and open on the bottom and provided with notches in its side flanges and a clamping piece provided with notches and fitting up within the socket, so that the latter projects down around it on all sides.

527,257. Electrical Signal. Harry H. Wister, Colorado City, Colo. Application filed April 10, 1893.

The object of the invention is to provide a signal which will apprise the engineer or other person on a train of the approach of another train on the same track, either from the front or rear, and also notify the engineer of a destroyed bridge, or a cave-in of a tunnel, or falling of a rock, or other obstruction on the track, or open switch.

527,258. Signal Recording Device. William H. Adkins, Rome, Ga. Application filed December 29, 1893.

The invention relates to an improved electric register and more especially to that class of signaling systems employing a central office or station and a number of signaling stations electrically connected to the central station, at which latter station the signals sent in from the signal stations are automatically recorded.

527,265. Conduit System for Electric Railways. William A. Butler, New York, N. Y. Application filed April 20, 1894.

In this system the contact boxes may be located in the conduit in such a way that the under face of the shoe or brush carried by the car will form contact with the conducting part of the outer shell, and cause the required movement thereof, or the boxes may be arranged within the conduit in any of the ways or according to any of the systems well known in the art and to which they are applicable.

527,267. System of Electric Block Signals for Railways. William M. Cuthbert, Brooklyn, N. Y. Application filed February 16, 1893.

The inventor, who has filed a patent, in which there are fifteen claims, divides a railroad into a number of longitudinal sections, each section being provided with, and represented by an office, and also subdivides the sections into blocks, each block being provided with and represented by a signal post, the posts being electrically connected the one with the other by an open circuit of high electromotive force, and with the office by a closed circuit of low electromotive force, also having in mechanical connection a device for setting a signal in the cab of a passing locomotive, this device being stationed in advance of the post and actuated simultaneously with, and by the changing of, the signal at the post, a signal in the cab of a locomotive having means of connection with a signal setting device, whereby the cab signal is set to indicate danger if the next block is closed (occupied), the posts also automatically telegraphing the section office of the passage of trains, number of cars in the train and the condition of the several blocks in the section.

527,285. Incandescent Lamp Socket. Luke R. Peck, St. Johns, Mich. Application filed April 10, 1894.

The invention consists in the peculiar construction of a lamp socket; first in the construction of the switch block or body, having a wall or diaphragm, upon opposite sides of which the terminals are adapted to be secured, so that in working about the socket, inserting the binding screws, etc., with tools or other metal instruments the short circuiting of the current is prevented; and second, in arranging on this switch block or body, fusible strips forming a part of the circuit, whereby the short-circuiting of the current will burn out but a single lamp.

527,294. Track Switch for Electric Railways. Augustin F. Schinner, Milwaukee, Wis. Application filed June 16, 1894.

The object of the invention is to provide, in combination with switch operating mechanism which is actuated by the core of the magnets, a single insulated strip in the wire, completing the circuit of the magnets, and which shall serve, when contact is made therewith by the trolley of one car, to throw the switch point in one direction, and when contact is made therewith by the trolley of the succeeding car, to throw the switch point in the opposite direction.

527,298. Electric Battery. Milton E. Smith and Maurice F. Geer, Rochester, N. Y. Application filed March 29, 1894.

An electric battery, comprising a jar, a negative electrode extending into a suitable fluid contained in the jar, a porous cup held in the jar and extending into the fluid, a positive electrode held in the porous cup, and an exciting fluid in the porous cup, this fluid containing chromic acid, is described.

527,301. Conduit Electric Railway. James E. Toole, Northumberland, Pa. Application filed January 24, 1894.

The object of the invention is to produce a very simple and inexpensive conduit electric railway in which the conduit is exceptionally strong as well as cheap, which has perfect means for draining the conduit, and which is provided with a trolley hung in such a manner that it may pass easily around curves, which has means for guiding the trolley wheel on the line wire, and which has means for conveniently raising the trolley whenever it is desired to break the circuit.

527,304. Workman's Time Recorder. Edward G. Watkins, Gardner, Mass. Application filed July 22, 1893.

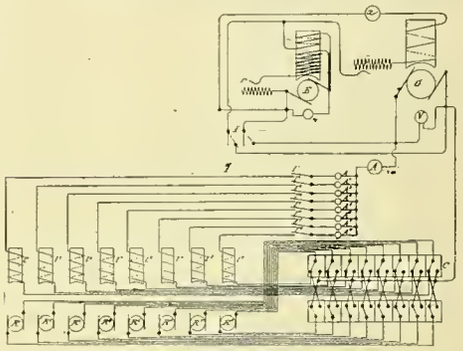
There is claimed in part in a time recorder, the combination with the case, a rotatable cylinder adapted to carry the time sheet and parallel pivoted marking levers, of two links pivoted to the case, a rod having its respective ends connected with the free ends of the links, the rod being arranged in the path of travel of the marking levers and essentially perpendicular thereto, a bell, and an operative connection between the rod and the bell.

527,317. Insulator. Edward J. Bullock, Wallingford, Conn. Application filed November 27, 1893.

The invention consists of an insulator having an inverted cup-shaped body constructed with a hub, which is adapted to have its base encircled by the wire, and a removable head applied to the hub, and constructed to overhang the base thereof by being made of larger external diameter than the same.

527,318. Insulator Pin. Edward J. Bullock, Wallingford, Conn. Application filed February 9, 1894.

The invention consists of an insulator pin for electric wires, having a long longitudinal bore formed in it, a metal reinforce located within the bore but shorter than the length of the same, and a plug fitted tightly into the open end of the bore over the outer end of the reinforce and sealing the same within the pin.



NO. 527,244.

527,355. Trolley Wire Support or Hanger. S. C. Woodhead, Philadelphia, Pa. Application filed April 24, 1894.

The object of the invention is to provide a device which can be attached to a separate and distinct wire, having no electric connections, and which will have one of its arms extending beneath the trolley wire at all times and thereby preventing the trolley falling to the ground.

527,375. Thermostat. Lewis G. Rowland, Camden, N. J. Application filed June 5, 1893.

One of the features of the invention is that the inventor proposes to arrange the body of the thermostat within the wall or ceiling in such manner that the cap or head only will be visible, and this cap or head may be ornamented in any desired manner or may be sunk flush with the line of the wall and colored in the same manner as the wall itself.

527,377. Apparatus for Mounting and Operating Thermopiles. Melvin L. Severy, Boston, Mass. Application filed February 16, 1894.

This invention relates to devices for the production of electricity by the action of solar heat upon a thermopile and has for its object the constant production of an electric current during the apparent diurnal and annual movements of the sun, without the necessity of moving the thermopile in accordance with the apparent movements of the sun.

527,378. Apparatus for Utilizing Steam for Heating Thermopiles. Melvin L. Severy, Boston, Mass. Application filed February 16, 1894.

The object of this invention is the utilization of the heat of the exhaust steam of an engine for the production of electricity and to heat the feed water for the boiler, and to this end the invention consists mainly in the combination with a steam boiler and engine of a thermopile, one face of which is heated by the exhaust steam and the other face cooled by the feed water supply.

527,379. Apparatus for Generating Electricity by Solar Heat. Melvin L. Severy, Boston, Mass. Application filed February 16, 1894.

One of the claims is for the combination of a thermo-electric pile, a case containing it having its side opposite the face of the pile composed of some material which is transparent to the rays of the sun, but opaque to dark radiated heat, a space between the front wall and the face of the pile, mechanism for moving the pile in accordance with the apparent annual and diurnal movements of the sun, a space between the back wall of the case and the back of the pile, two pipes communicating at one end with this space and at the other with a source of water under pressure, whereby a current of water is caused to flow through the last mentioned space.

527,393. Busy Test for Multiple Switchboards. Robert H. Polk, Savannah, Ga. Application filed April 20, 1894.

There is described in a busy test for multiple switchboards a high tension current source, a connecting loop, and a condenser of such capacity that the talking current will not pass through it, interposed in the wire connecting the source and loop, and a test-plug circuit.

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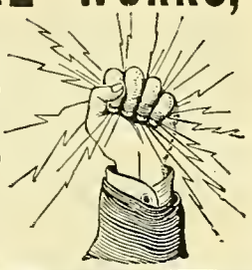

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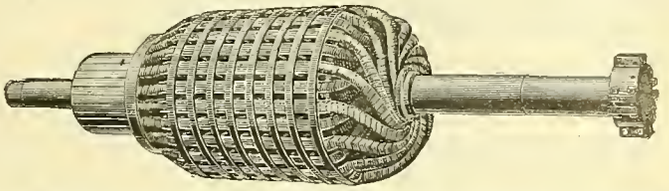

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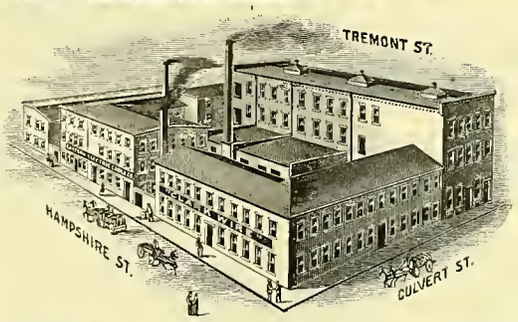


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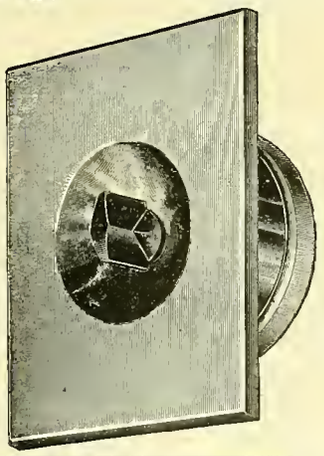

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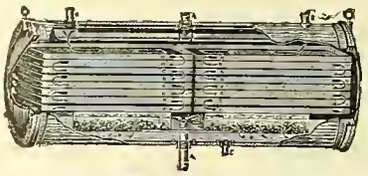

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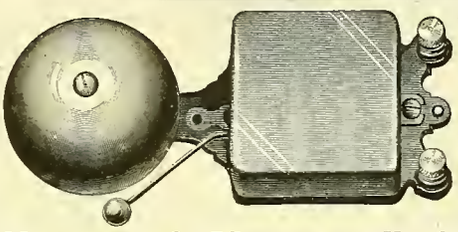

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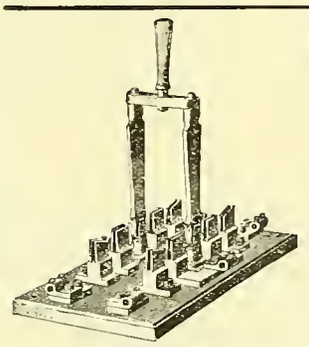

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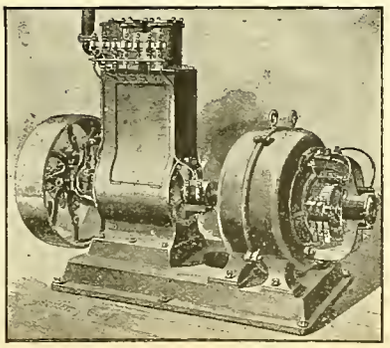

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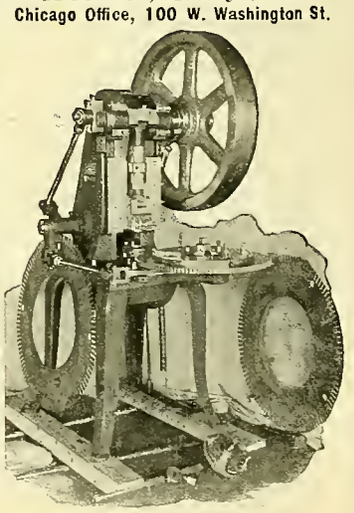

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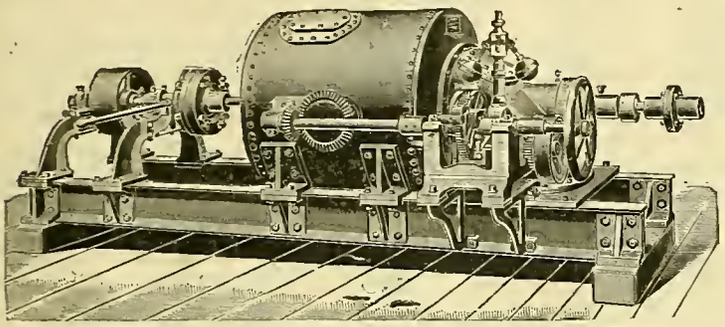

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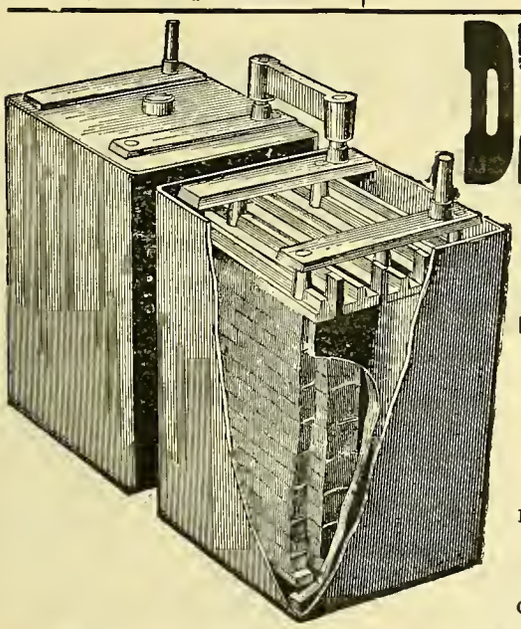

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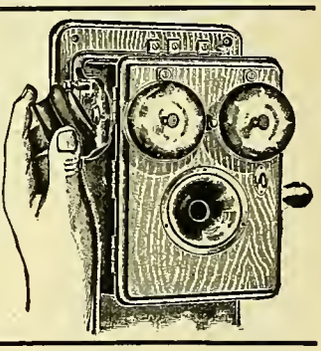

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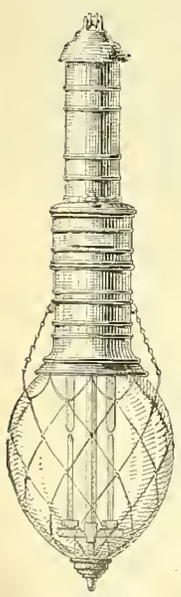
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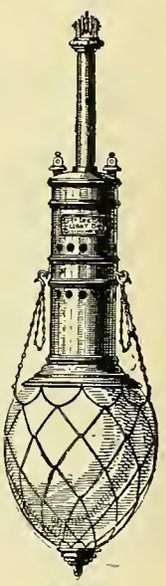
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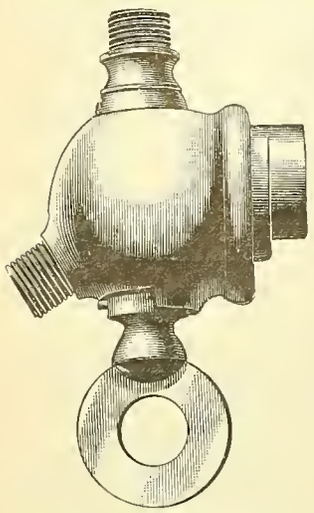

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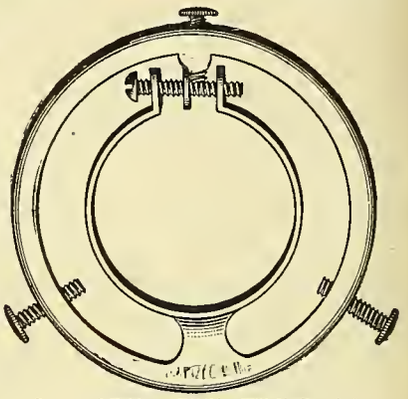

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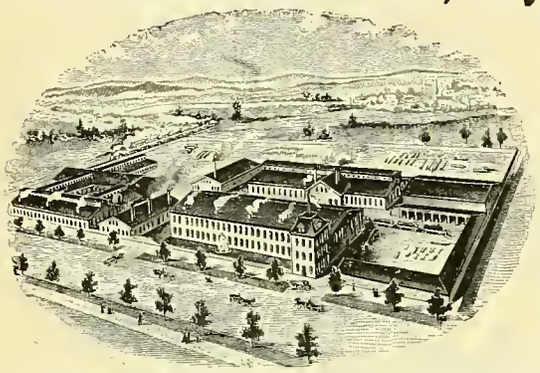

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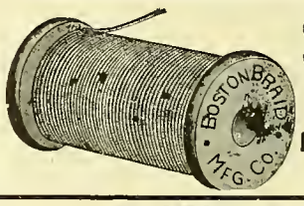


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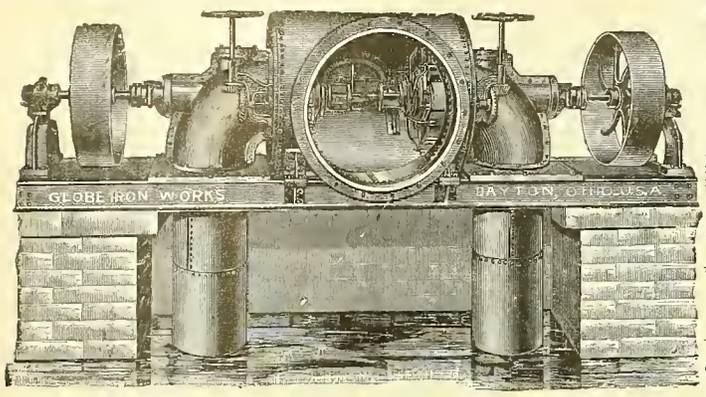


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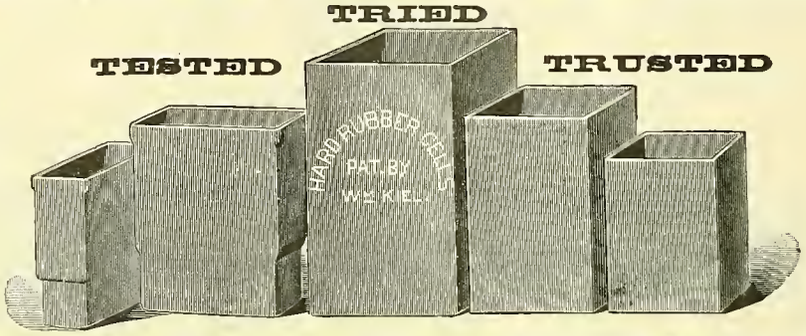


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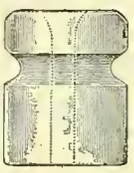

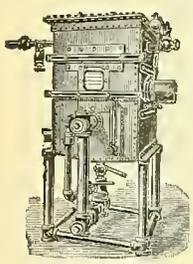

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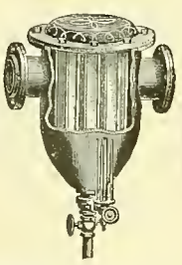

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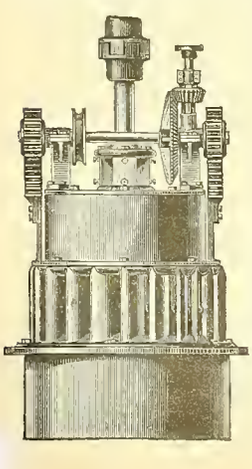

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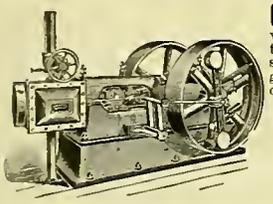

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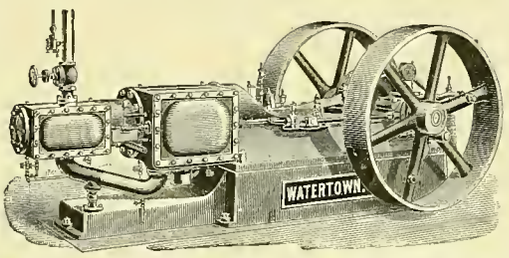


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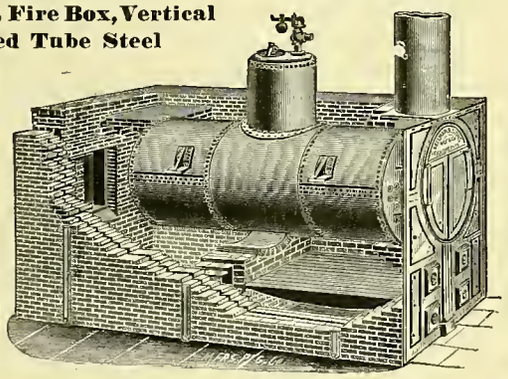

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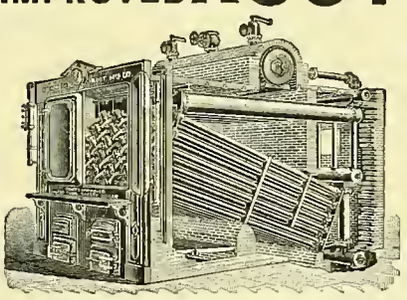

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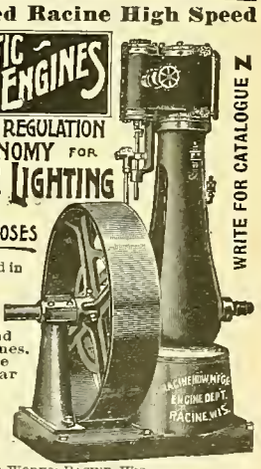

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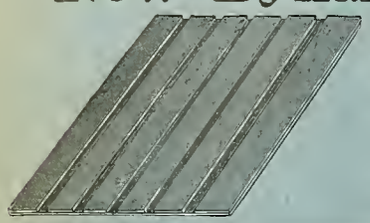

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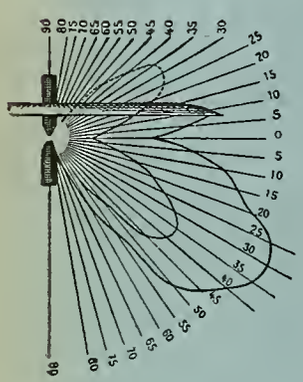

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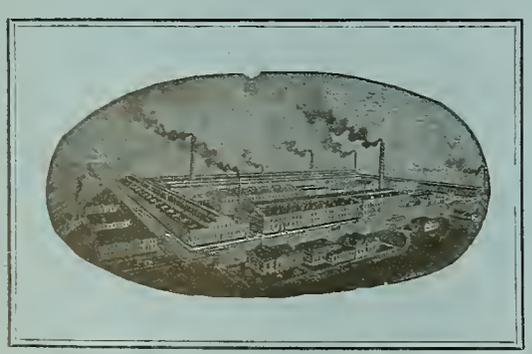

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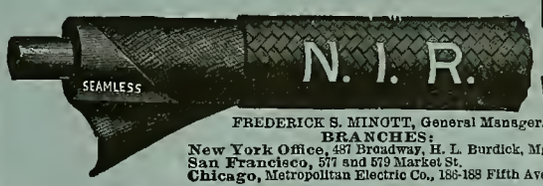


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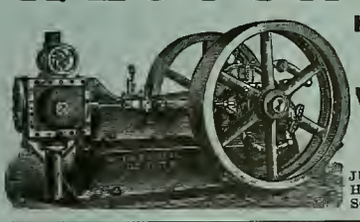

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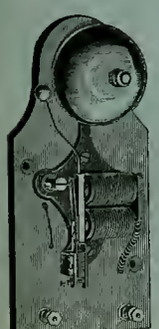

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## CLASSIFIED LIST.


**Accumulators.**
Accumulator Co.
Boswell & Co., D. E.,
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Hascke & Creelmso.
Porter & Buerdorf.

**Annunciators.**
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitao Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
Auerbach-Woolverton El. Co.
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Ine'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Arc Light Cord.**
Samson Cordage Wks.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Central Electric Co.
Electric Appliance Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Hascke & Creelman.
Hayden-Booker Mfg. Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Partrick & Carter Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Western Electric Co.

**Belting.**
Shultz Belting Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co., The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electriciau Publishing Co.

**Brushes.**
Partridge Carbon Co.

**Burglar Alarms.**
Central Electric Co.
Electric Appliance Co.
Hoggson & Co.
Metropolitan Electric Co.
Partrick & Carter Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric.** (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Cushing & Morse.
Eastern Electric Cable Co.
Hill, W. S. Electric Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Norwich Ins. Wire Co.
Roehling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons, Points & Plates.**
Central Electric Co.
General Electric Co.
Jennings, A. R.
Metropolitan Electric Co.
Partridge Carbon Co.
Reisinger, Hugo.
Western Electric Co.

**Car-Heaters, Electric.**
Consolidated Car-Heating Co.

**Castings.**
Dutcher Co., J. A. & P. E.

**Clocks, Electric.**
Self-Winding Clock Co.

**Conduits**
Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation
Muncie Elec. Mfg. Co.
Washington Electric Co.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Metropolitan Electric Co.
National India Rubber Co.
Okonite Co. The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cordage.**
Samson Cordage Wks.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Electric Appliance Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Royal Electric Co.
Rushmore, S. W.
Siemens & Balske Elec. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Economizers.**
Fuel Economizer Co.

**Elec. Heating Devices.**
Am. Electrical Heater Co.
Consolidated Car Heating Co.

**Electric Railways.**
Brush Electric Co.
General Electric Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Rushmore, S. W.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Diamond Electric Co.
Electric Appliance Co.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Large & Twining.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. B.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Engravers.**
Illinois Engraving Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Central Electric Co.
Interior Conduit & Ins. Co.
Muncie Elec. Mfg Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co
Partrick & Carter Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Electric Co.
Palmer Bros.
Partrick & Carter Co.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Induction Coils.**
Splitdorf, C. F.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Buonell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Fiberite Co., The.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Norwich Ins. Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Large & Twining.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Norwich Ins. Wire Co.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Mather Electric Co.
Metropolitan Electric Co.
New York & Ohio Co.
Partrick & Carter Co.
United Elec. Imp. Co.
Westinghouse Elec. & Mfg. Co.

**Lightning Arresters.**
Central Electric Co.
Diamond Electric Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery.**
Bliss Co., E. W.
Hine & Robertson Co.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

**Motors.**
Bolgiano Mfg. Co.
Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Royal Electric Co.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co.

**Packing.**
Garlock Packing Co.

**Paints.**
Standard Paint Co.

**Patents.**
Gooch, Chas. J.

**Phosphor Bronze.**
Phosphor Bronze Sm. Co. Ltd.

**Platinum.**
Baker & Co.

**Poles.**
Brownlee & Co.
Morris, Tasker & Co.
Nuttall Co., R. D.

**Porcelain.**
Empire China Works.
General Electric Co.
Phœnix Glass Co.

**Publishers, Electrical.**
Electrician Publishing Co.

**Push Buttons.**
Central Electric Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Partrick & Carter Co.

**Rheostats.**
General Electric Co.
Rushmore, S. W.

**Sal Ammoniac**
Hayden-Booker Mfg. Co.
Klipstein, A. & Co.
Law Battery Co.

**Second-Hand Electrical Machinery.**
Gregory, Chas. E. Co.
Rushmore, S. W.

**Separators.**
Goubert Mfg. Co.
Hine & Robertson Co.

**Silk Braid.**
Boston Braid Mfg. Co.

**Slate.**
Independent Electric Co.
Jennings, A. R.

**Speaking Tubes.**
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

**Speed Indicators.**
Diamond Electric Co.
Whitney Elec. Instrument Co.

**Steam Heating.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Steam Pumps.**
Worthington, Henry R.

**Storage Batteries.**
Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Hascke & Creelman.
Porter & Buerdorf.

**Street Cars.**
Brill, J. G. Co.

**Tapes, Insulating.**
American Electrical Works.
Central Electric Co.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Norwich Ins. Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
Central Electric Co.
Electric Appliance Co.
Metropolitan Electric Co.
Partrick & Carter Co.
Western Electric Co.

**Telephones.**
D'Unger Long Dist. Tel. Co.
Metropolitan Electric Co.
National Telep. Mfg. Co.
Palmer Bros.
Partrick & Carter Co.
Western Electric Co.
Western Tel. Const. Co.

**Telephone Hooks.**
Bradley & Co.

**Transformers.**
Diamond Electric Co.
General Electric Co.
Bornberger Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Trolley Cord.**
Samson Cordage Wks.

**Trucks, Electric Car.**
General Electric Co.
Westinghouse El. & Mfg. Co.

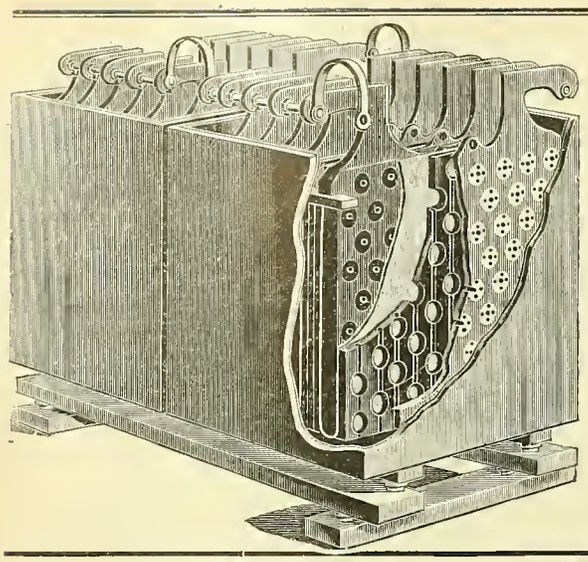
**Turbine Wheels.**
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

**Universities.**
Cor. School of Industrial Sciences.
Scientific Machinist Co.

**Varnishes.**
Standard Paint Co.

**Water Wheels.**
Leffel & Co., Jas.
Smith, S. Morgan.

**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Electric Appliance Co.
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.



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**The Only Storage Battery in Use in Central Stations, of American Manufacture.**

## The Electric Storage Battery Co.,

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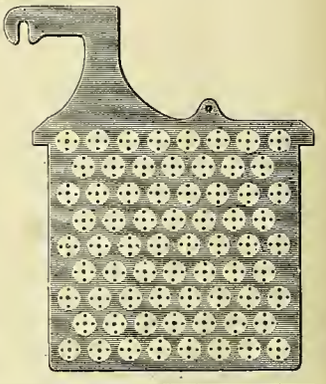
# Chloride Accumulator.

Registered September 11, 1894.



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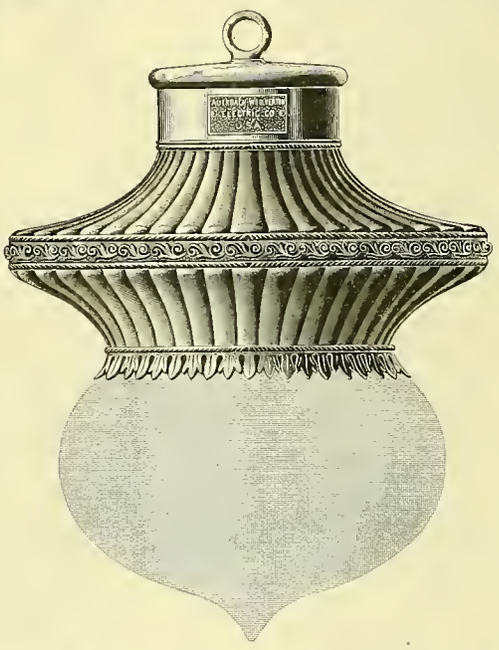
# THE A.-W. ARC LAMP.



That burns on any current.

That measures 18 inches from top to bottom (including globe).

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That throws light where you want it—on the ground.

That feeds neither by rack, clutch, clockwork, nor chain.

That casts no shadow whatever.

That gives the maximum light distribution.

That gives an absolutely steady light.

That keeps the arc stationary.

That feeds independent of the magnet.

**SIMPLICITY AND DURABILITY OF CONSTRUCTION.**

**THE MOST ORNAMENTAL LAMP IN THE MARKET.**

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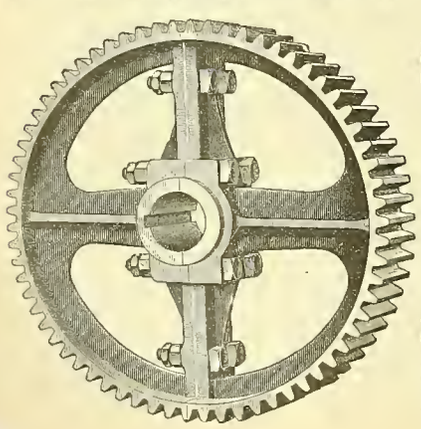

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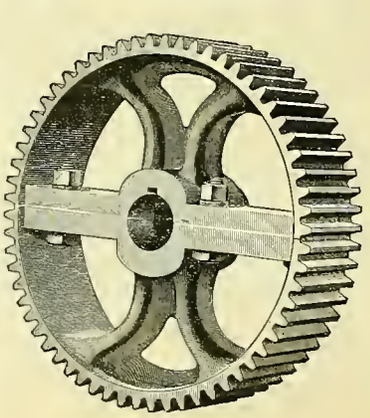
## Electric Railway Supplies.

**GEARS, PINIONS, BEARINGS, TROLLEYS, TROLLEY WHEELS AND HARPS.**

**THIS IS THE IMPROVED NUTTALL TROLLEY.**

**TRY IT ONCE, AND YOU WILL WANT NO OTHER.**



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STANDARD R'Y SUPPLY CO., Monadnock Block, Chicago, Ill., N. W. States Sales Department.
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# One of the pleasant reflections about Okonite

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***It never disappoints.***

We do not believe that this can be predicated of any other insulated wire.

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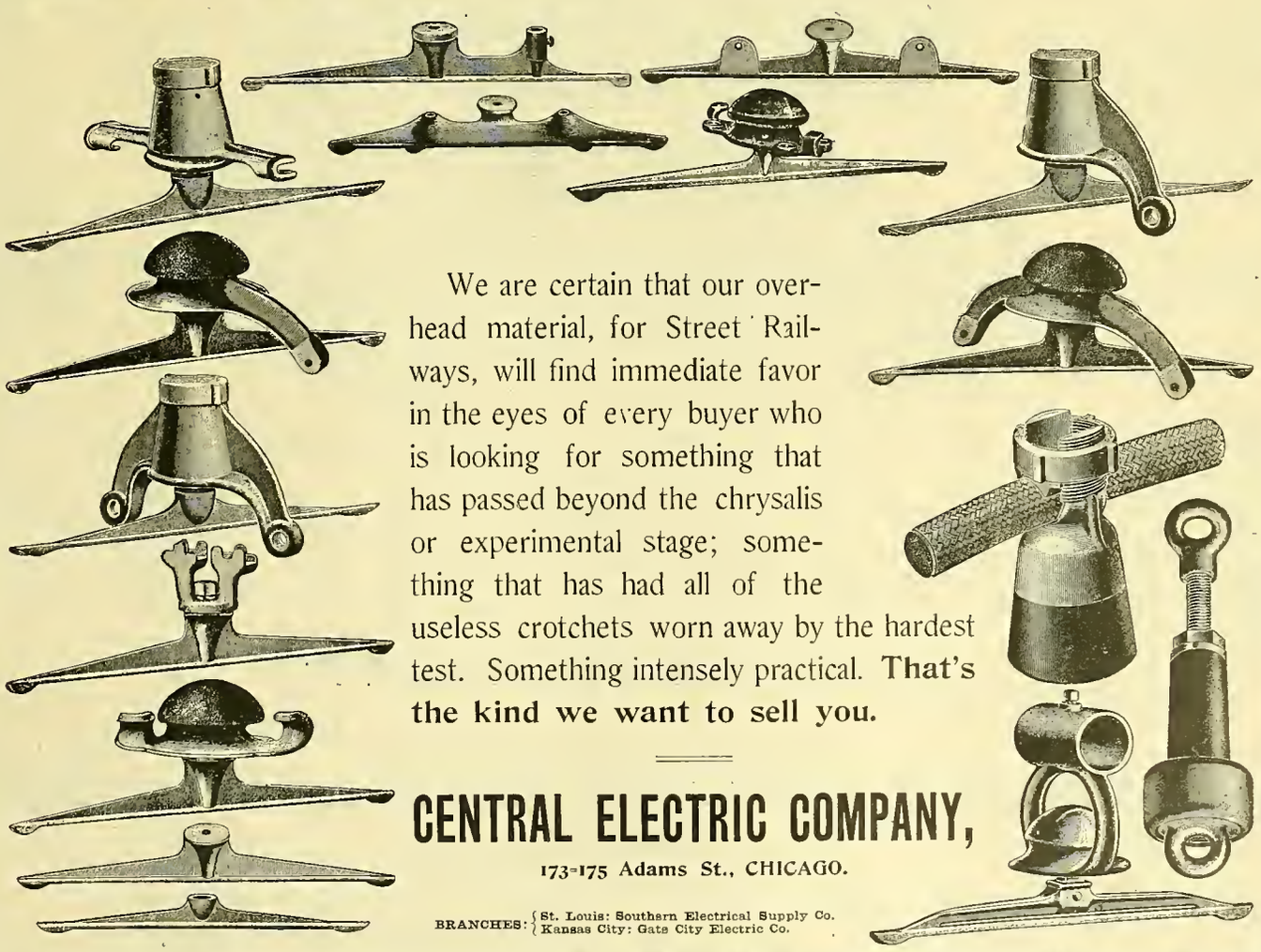

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*Patentees and Manufacturers of*

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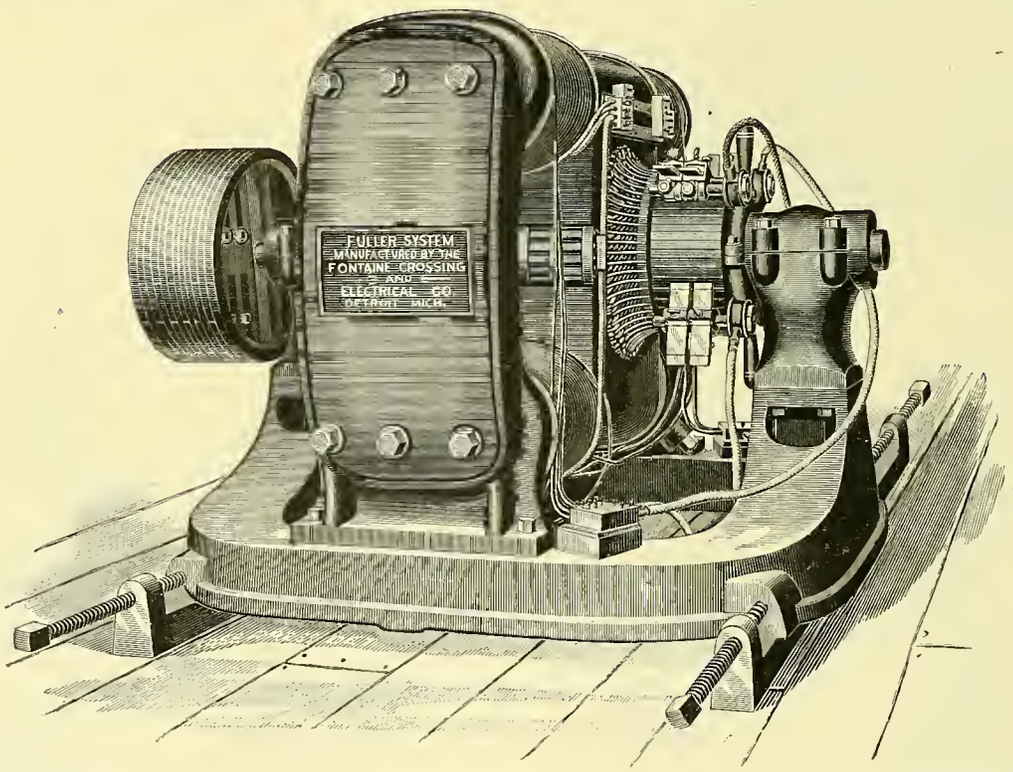
FULLER AUTOMATIC DYNAMOS AND MOTORS,
FULLER COMBINATION FAN-MOTOR

AND

# FULLER DOUBLE-VOLTAGE DYNAMO.

**The Only Double Voltage**

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Will develop either or both 110 and 220 Volts in any quantity up to the rated capacity of the machine.

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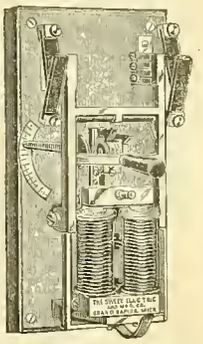

To the Greenville Oct 12th 1894
Sweet Electric & Mfg. Co.
Grand Rapids Mich.

Dear Sirs: We placed one of your alternating switches on our switch board and in less than ten hours it payed for itself. We got a dead short circuit on the commutator. The machine made one jump and the switch had done its work.

I fixed up the commutator and placed it back and it has run ever since.

The long and short of it is we saved an armature by having your switch on our board.

Very Truly Yours,
W. B. Serviss, Sup.
Greenville Electric Light Works,
Greenville Mich.

Do your armatures burn out? Of course they do, unless your plant is protected by one of our

## AUTOMATIC LIMIT SWITCHES.

We afford protection to any machine generating or using electric current.

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You thought we could not break the alternating current, but you see we can.

Write to

**SWEET ELECTRIC AND MFG. CO.**
**Grand Rapids, Mich.**

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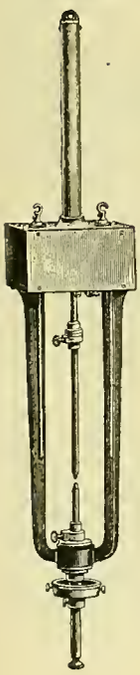

# STANDARD "WARD" LAMPS

**For Direct Current, 110 Volts.**

## TEN DOLLARS EACH

**With Globe and Resistance, $2.00 Extra.**

**There are more lamps of the above type in use in the United States on Incandescent Circuits, than all other makes combined.**

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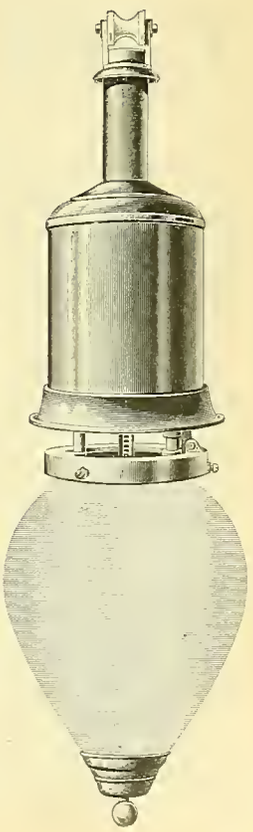

### ALTERNATING LAMPS.

Our new Alternating Lamp is the most economical and surest feed lamp on the market, burning from secondary circuits of 33, 50 or 100 volts.

Simplicity and strength of construction are the strong points of our lamps, rendering them more durable and easier to maintain than any others.

Lamps ENTIRELY WATERPROOF, dispensing with the use of hoods.

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## ELECTRIC CONSTRUCTION & SUPPLY CO.,

**Established 1881.** **18 Cortlandt Street, New York.**

WALLACE ELECTRIC CO., Agents, 307 Dearborn St., Chicago, Ill.

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# MEDBERY INSULATION

Has been adopted by a majority of the leading roads in the United States.

**NOW THE STANDARD FOR CONSTRUCTION.**

Highest Electrical Resistance and Greatest Tensile Strength.

**SOLD UNDER AN ABSOLUTE GUARANTEE.**

# THE FIBERITE COMPANY,

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# We Want Western Business.

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Manufactured in Sizes from

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**SINGLE**
OR
**MULTIPHASE.**

Direct Connected Dynamos.

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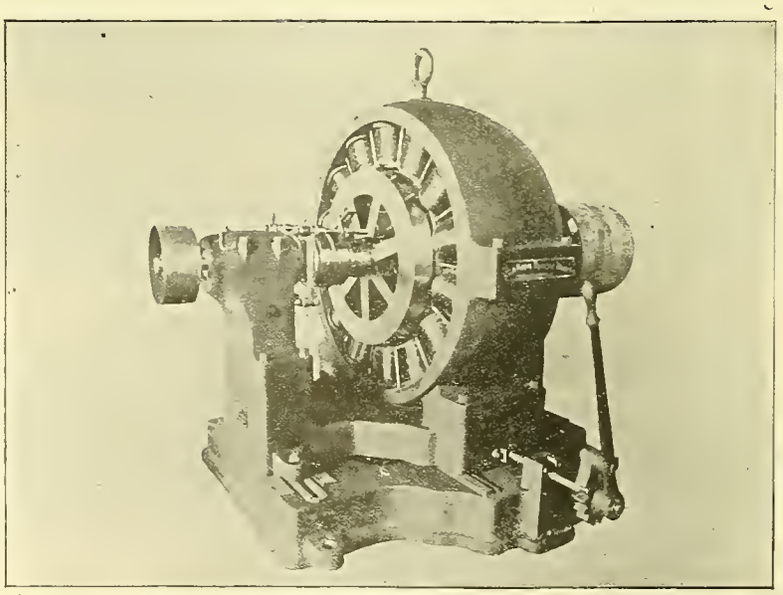

1,000 Light Alternator.

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Highest Efficiency Ever Obtained.

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To order for any purpose, voltage or capacity.

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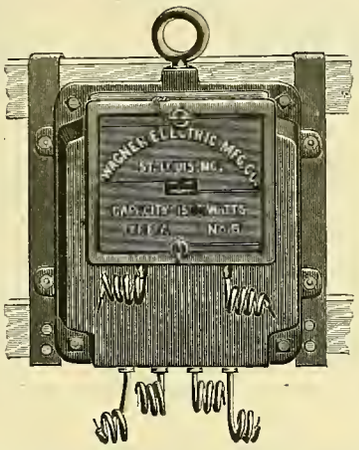


Standard Sizes, 5 Lights to 2,000 Lights.

**HIGH POTENTIAL SWITCHES,**

Complete Switch Boards

For Central Stations and Isolated Plants.

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"NATIONAL" COMPOUND RECEIVER.

## THE "NATIONAL."

We make simply a business proposition. Buy two sets of our instruments and make your own tests. If satisfactory the way is open for more business, either in telephones or switchboards for exchanges.

**Our head telephones are largely used by Bell telephone operators.**

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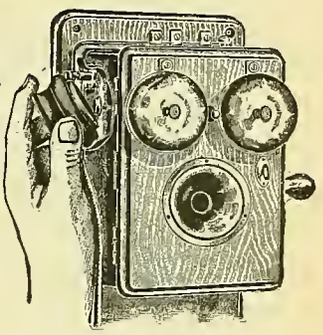

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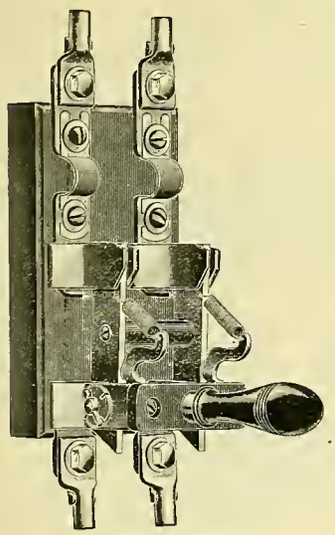
SIMPLE, DURABLE, RELIABLE AND CHEAP.



Copper Snap Knife Switch on Porcelain Base.

These Switches made in capacities running from 75 to 300 amperes, double or triple pole, are of pure copper stampings and are mounted on porcelain bases. They are so constructed that waste of current in heat is eliminated. As a cheap reliable switch they stand unrivaled.

**Write for our prices on these.**

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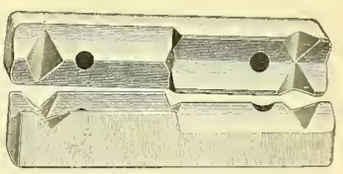
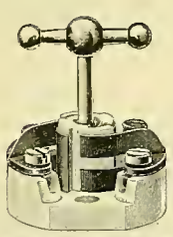
These illustrations represent articles made of porcelain manufactured by us at our own porcelain factory. It is hard, white and vitrified and has the highest possible insulation. It is the only porcelain for electrical purposes which satisfies the requirements of the United States Government.

**Write for our Illustrated Catalogue.**



Porcelain Cleat.



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Philadelphia, Pa., 509 Arch St.
Pittsburgh, Pa., 425 Wood St.
Baltimore, Md., 227 E. German St.
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Cincinnati, Ohio, 264 W. Fourth St.
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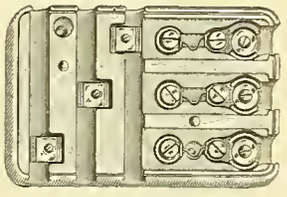

Porcelain Link Cut-Out.

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## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

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Electric Motors, Automatic or Hand Controlled.
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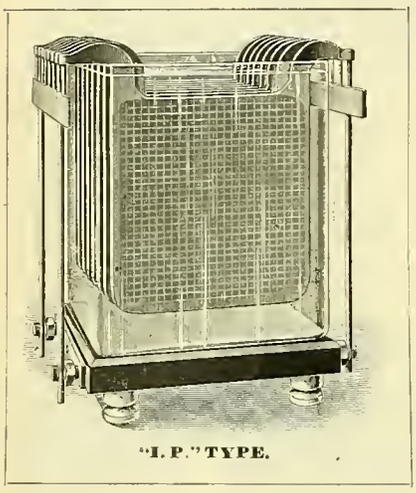

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FOR CENTRAL STATIONS

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New Type with Independent Plates which can be Easily Examined and Replaced without interfering with Charge or Discharge. Capacity from 350 to 12,000 Ampere Hours. No Nuts, Bolts or Screws. Meets all Requirements of Central Stations.

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The Largest Hotel of its kind in the World. Is wired complete from

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**Manufacturers: INDIANA RUBBER AND INSULATED WIRE COMPANY, Marion, Ind.**

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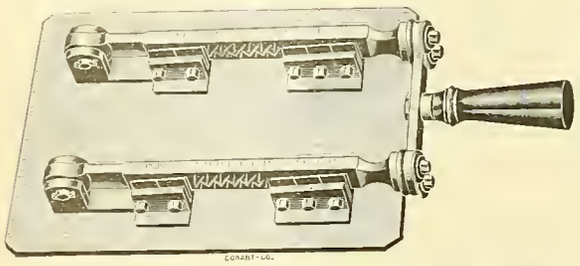

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WHITE OAK PINS.

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The strongest castings made. The wrought iron castings are very desirable for electrical purposes.

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For Operating Phonographs and Motors,
Also for ELECTRIC LIGHTING.

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Suitable for all Incandescent Dynamos, Plating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.

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Samson Spot Cord

For Arc Light and Trolley Cord.

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Write for Circulars descriptive of

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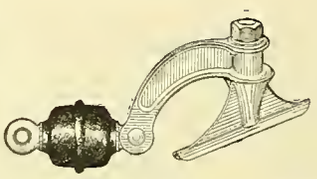

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Designed with reference to strength, durability, high insulation, reliability and practical fitness for the work they have to do. In universal use.

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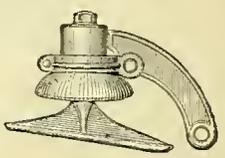
Magnet Spools, Controller Parts, Bushings, Etc.



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5 and 10 Ampere Single Pole.
10 Ampere Double Pole.
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The Only Snap Switch that has
PROVEN A SUCCESS.

For Sale by All Supply Houses.

The Hart & Hegeman
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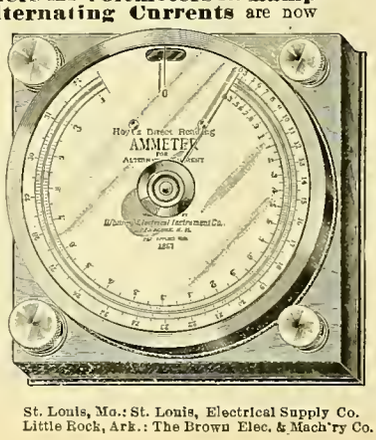
# Something New.

The **Hoyt Standard Ammeters** and **Voltmeters** for **Lamp** and **Meter** measurement on **Alternating Currents** are now ready for the market.

Send for our **1894 Catalogue** which contains the above and other new instruments of our manufacture.

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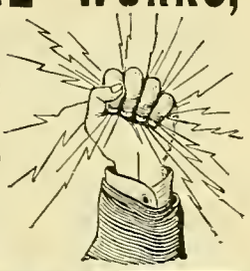

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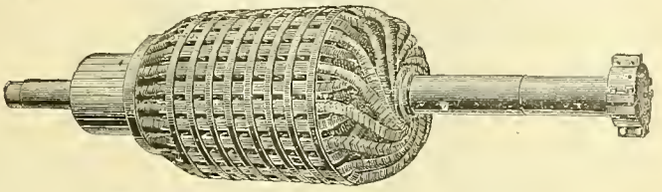
Are Necessary for All-around Station Economy



The above cut is of a 176 K. W. Generator wound on our new open-head spiral system. All coils alike, perfect balance, handsome appearance Write for prices on **HEAVY CENTRAL STATION REPAIRS**; *Large Commutators*, Search Lamps and Station Dynamos.

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TRADE MARK.

For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

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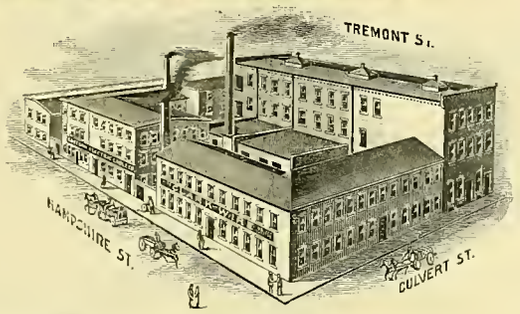


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The Rubber used in insulating our Wires and Cables is especially chemically prepared, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat.

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ALL KINDS PRICES OF PARTS TELEPHONES ELECTRICAL SUPPLIES

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TRADE MARK. WIRES "IDEAL" AND CABLES

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**It will not Deteriorate by long use, nor Oxidize the Copper. Finished in the following Styles: Black Polished, White and Black Glazed Braid and White Fireproof.**

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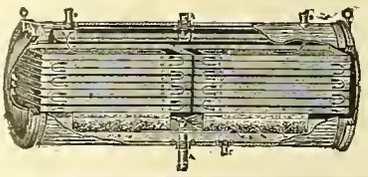
## Stilwell's Patent Live Steam-Feed Water Purifier.



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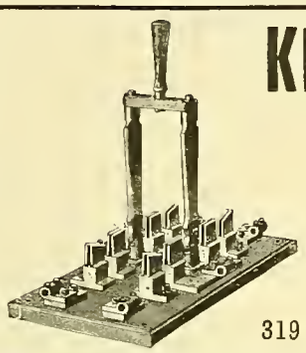

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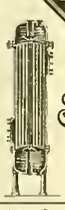

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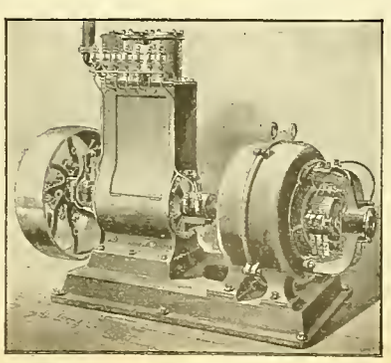

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*In the matter of the assignment of the St. Paul and Minneapolis Messenger and Telephone Company.*

Notice is hereby given that the undersigned, the assignee for the St. Paul and Minneapolis Messenger and Telephone Company, a corporation, at his office in the Manhattan Building, in the City of St Paul, Minnesota, on the 14th day of November A. D. 1894, at 10 o'clock in the morning of said day will sell to the highest bidder for cash therefor, all the wire, messenger call boxes, batteries, office furniture and fixtures, and all book accounts due to said company. Said sale being made subject to approval by the District Court in and for the County of Ramsey, Minnesota.

Notice is also given that the undersigned will apply to the District Court in and for the County of Ramsey, Minnesota, at a special term of said court, to be held in the City of St. Paul, Minnesota, on the 17th day of November, A. D. 1894, at 10 o'clock in the forenoon on said day or as soon thereafter as counsel can be heard, for an order confirming said sale.

Dated St. Paul, Minn., Oct 18, 1894.

ROBERT L. WINNE, Assignee.

A majority of the stock can be transferred at above sale. Plant is now in operation and so can be continued under one of the most valuable franchises in the City of St Paul.

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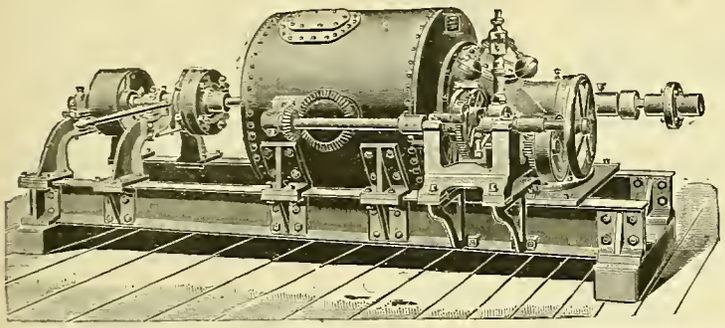

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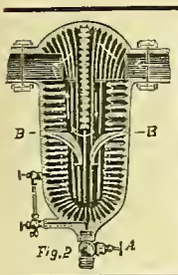


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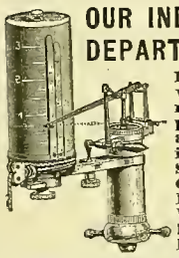

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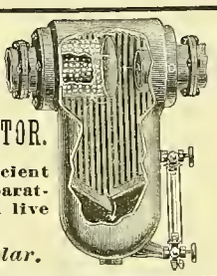

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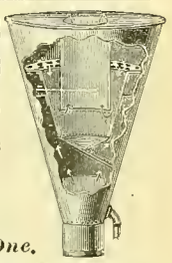

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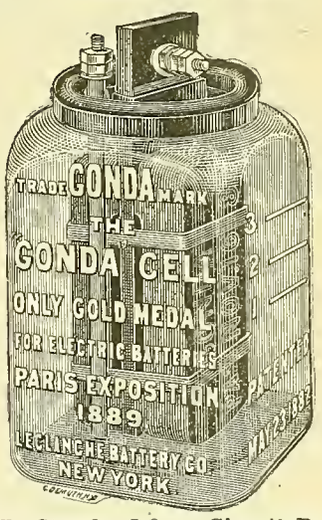


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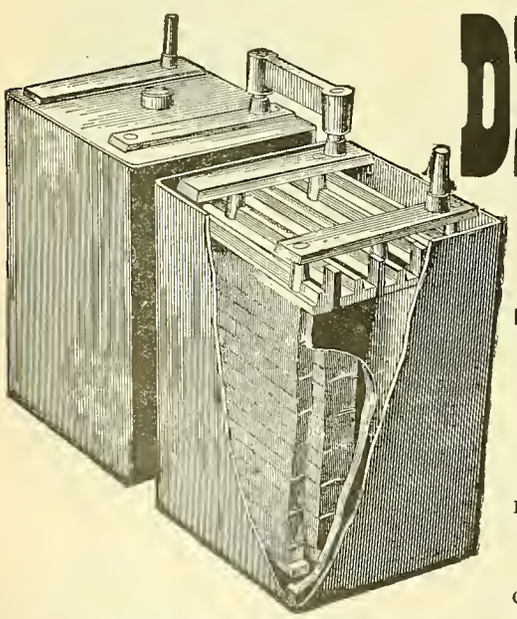

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I find the amount of:

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|---|---|---|---|---|---|
| Ammonium Chloride | contained | therein | to be | 99.51 | per cent. |
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| Moisture | " | " | " | 0.13 | " |
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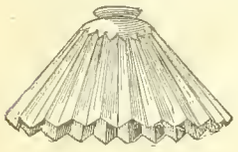

Radial Fluted.

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|---|---|---|---|---|
| 17 in. | diameter, | 2¼ in. | holder, | $ 9.00 |
| 8 " | " | 2¼ " | " | 10.00 |
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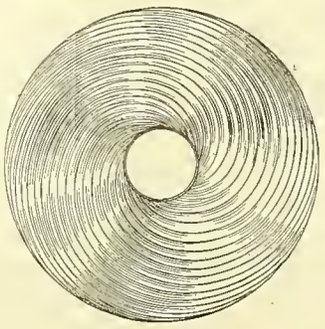

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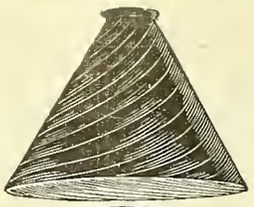

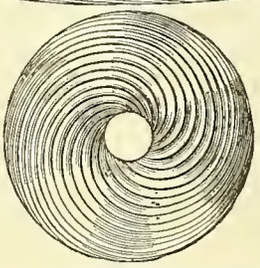

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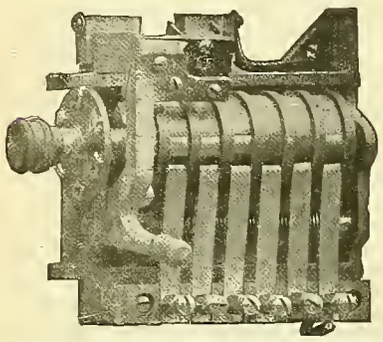

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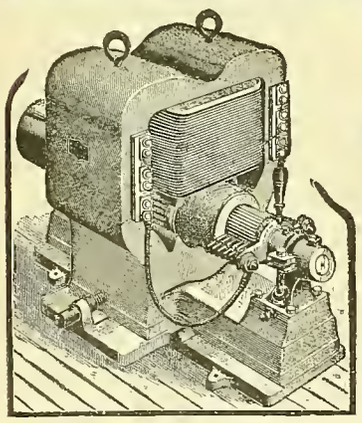

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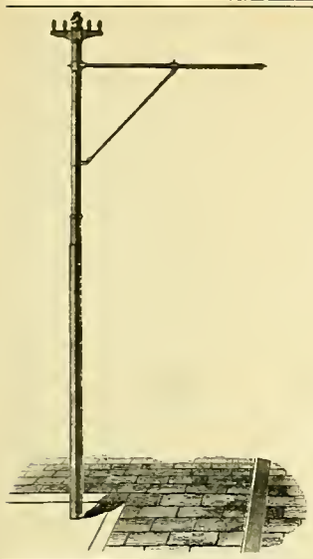

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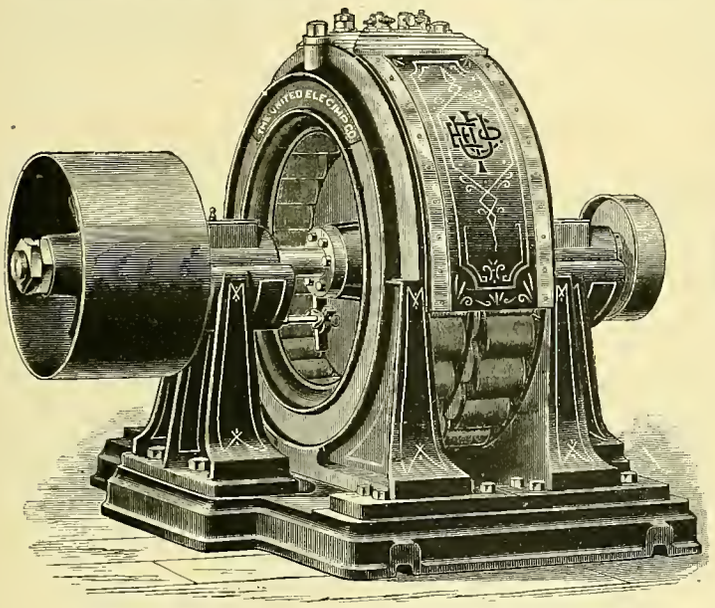

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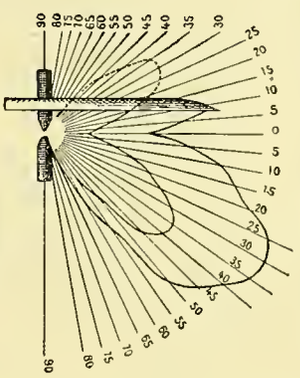

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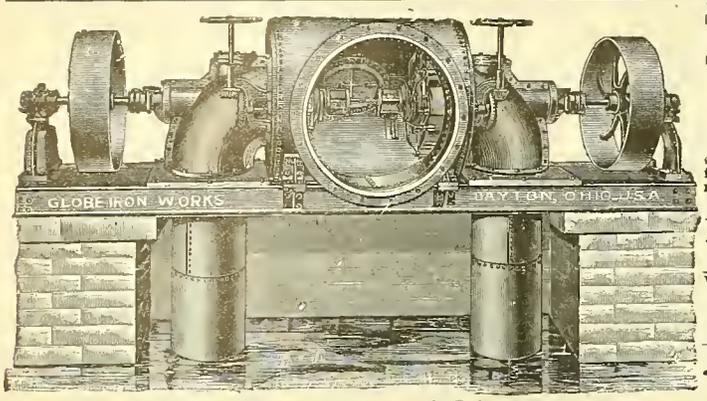


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|---|---|---|---|---|---|
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| ⅞ " | 16.42 | 122.00 | 127.18 | 195.19 | 82.68 |
| ¾ " | 16.78 | 117.33 | 112 60 | 175.74 | 82.18 |
| ⅝ " | 17.03 | 111.83 | 98.12 | 149.99 | 79.31 |
| ½ " | 16.88 | 118.67 | 82.07 | 118 40 | 75.52 |

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| | Head. | Rev. per Min. | Cu. Ft. per Sec. | Horse Power. | Per Cent |
|---|---|---|---|---|---|
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| ⅞ " | 16.66 | 134.80 | 120.85 | 188,14 | 83.09 |
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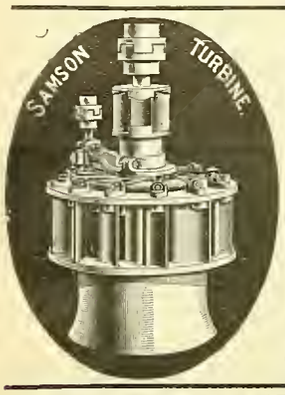


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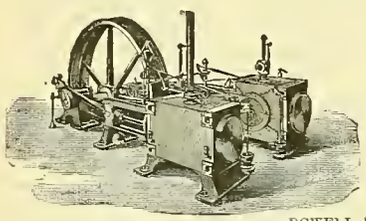

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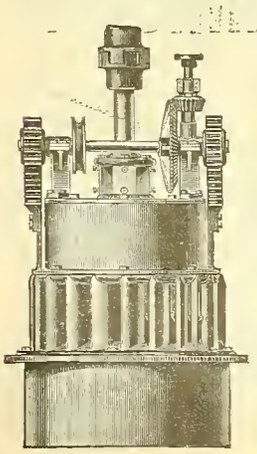

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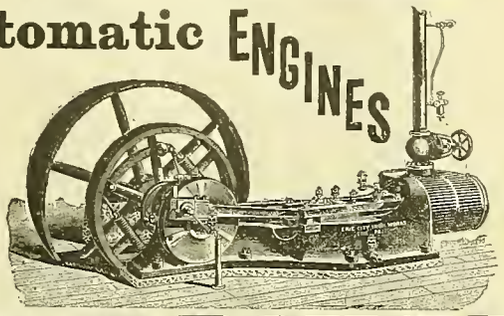

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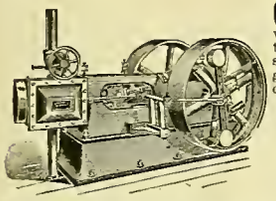

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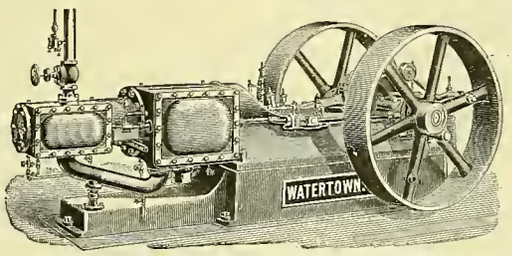


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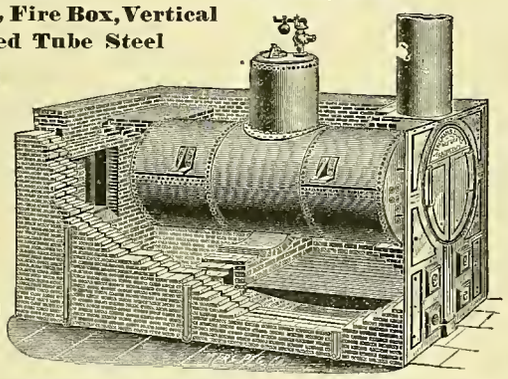

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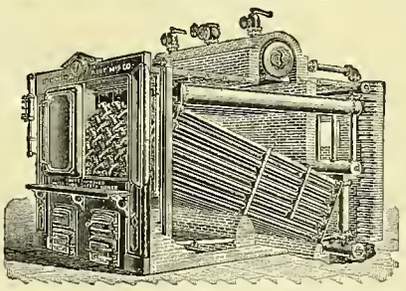

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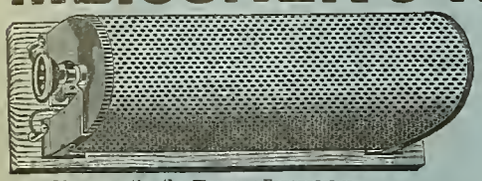

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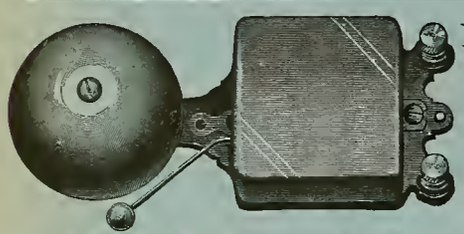

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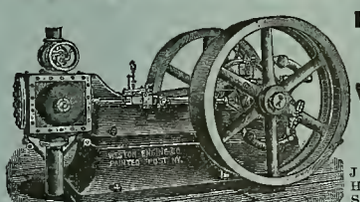

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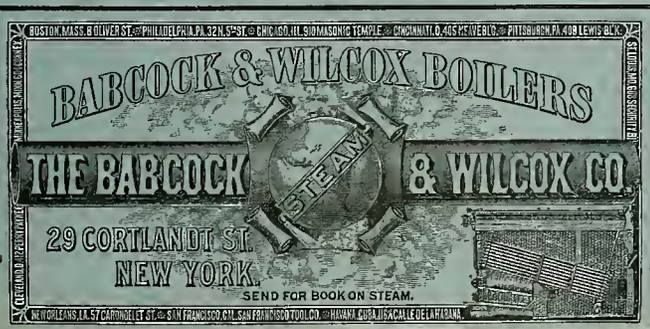


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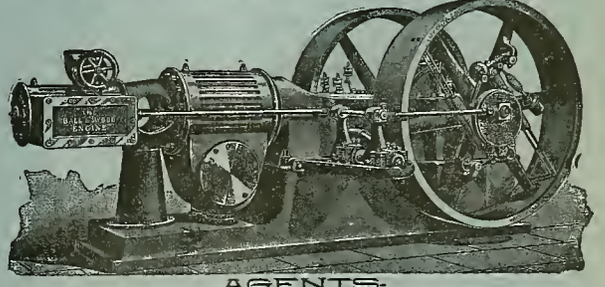

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Dixon Crucible Co., Jos.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Induction Coils.**
Splitdorf, C. F.

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Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Jennings, A. R.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
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Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Large & Twining.
Metropolitan Electric Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
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Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Mather Electric Co.
Metropolitan Electric Co.
New York & Ohio Co.
Partrick & Carter Co.
United Elec. Imp. Co.
Westinghouse Elec. & Mfg. Co.

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Diamond Electric Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.

**Magnet Wire.**
(See Insulated Wires.)

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Hice & Robertson Co.

**Mica.**
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Munsell & Co., Eugene.

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Independent Electric Co.
Westinghouse El. & Mfg. Co.

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Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Royal Electric Co.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co.

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Garlock Packing Co.

**Paints.**
Standard Paint Co.

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Gooch, Chas. J.

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**Platinum.**
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Morris, Tasker & Co.
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Metropolitan Electric Co.
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Whitney Elec. Instrument Co.

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Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
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Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

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Electric Appliance Co.
Metropolitan Electric Co.
Partrick & Carter Co.
Western Electric Co.

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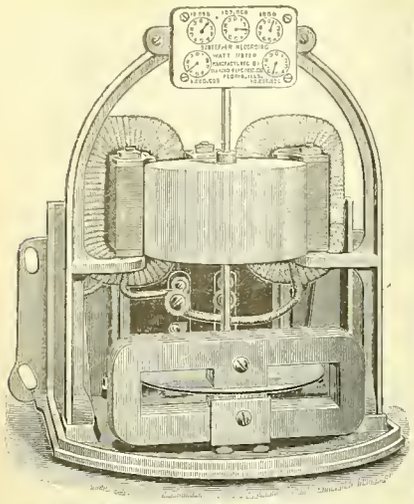
Bishop Gutta Percha Co.
Central Electric Co.
Electric Appliance Co.
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.



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# SCHEEFFER'S RECORDING WATT-METER.

For Alternating Circuits. No Commutator. No Brushes.

Registers Direct Actual Power Consumed.

EASILY ADJUSTED. ABSOLUTELY RELIABLE.

# DIAMOND TRANSFORMER.

Simplest, Safest and Best.

FOR ANY VOLTAGE. FOR ALL SYSTEMS.

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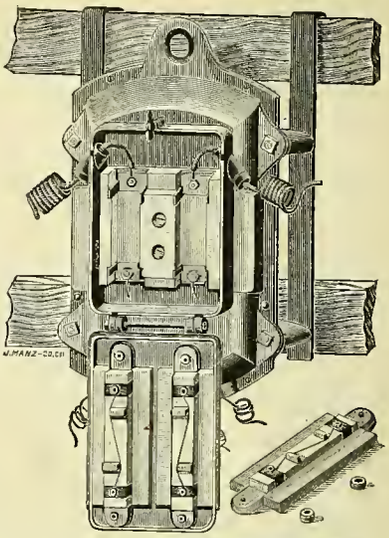
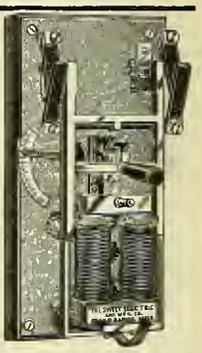


# How is This?



To the Greenville Oct 12th 1894
Sweet Electric & Mfg. Co.
Grand Rapids Mich.

Dear Sirs:—We placed one of your alternating switches on our switch board and in less than ten hours it payed for itself. We got a dead short circuit on the commutator. The machine made one jump and the switch had done its work. I fixed up the commutator and placed it back and it has run ever since.

The long and short of it is we saved an armature by having your switch on our board.

Very Truly Yours
W. B. Serviss Sup.
Greenville Electric Light Works
Greenville Mich.

Do your armatures burn out? Of course they do, unless your plant is protected by one of our

## AUTOMATIC LIMIT SWITCHES.

We afford protection to any machine generating or using electric current.

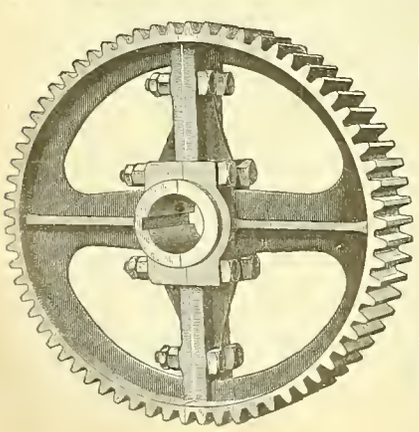
You thought we could not break the alternating current, but you see we can. Write to

## SWEET ELECTRIC AND MFG. CO.

**Grand Rapids, Mich.**

# R. D. NUTTALL COMPANY, Allegheny, Pa.

F. A. ESTEP, President and Treasurer.
J. R. McGINLEY, Vice-President.
F. S. MARTIN, Superintendent of Works.



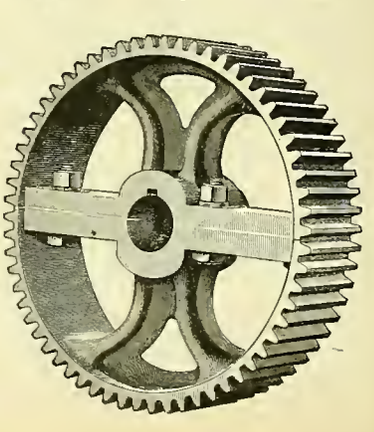
MANUFACTURERS OF

## Electric Railway Supplies.

GEARS, PINIONS, BEARINGS, TROLLEYS, TROLLEY WHEELS AND HARPS.

THIS IS THE IMPROVED NUTTALL TROLLEY.

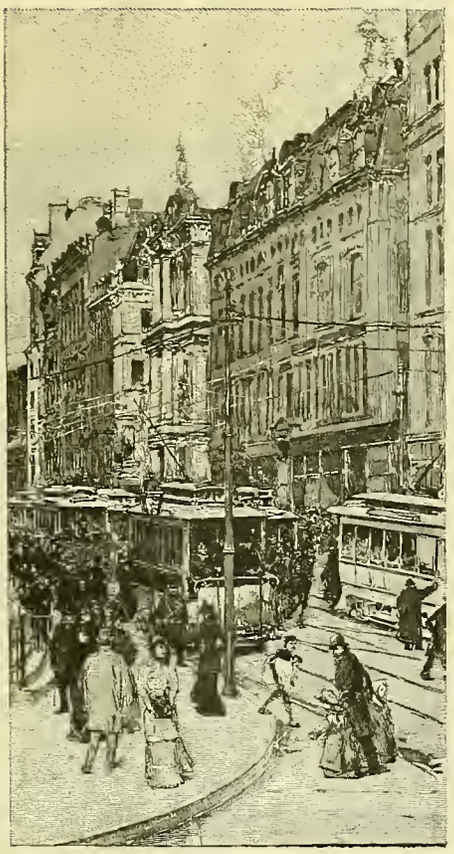
TRY IT ONCE, AND YOU WILL WANT NO OTHER.



**The largest and most prosperous street railway companies in the country are using our supplies, and they prefer them to all others on account of greater strength and durability. Correspondence solicited.**

CHAS. J. MAYER, 600 Betz Building, Philadelphia, Pa., Middle States Sales Department.
CHAS. N. WOOD, 180 Summer St., Boston, Mass., New England States Sales Department.
STANDARD R'Y SUPPLY CO., Monadnock Block, Chicago, Ill., N. W. States Sales Department.
A. S. PARTRIDGE, Bank of Commerce Building, St. Louis, Mo., S. W. States Sales Department.
CHAS. A. CAVAGNA, Neave Building, Cincinnati, Ohio, Central States Sales Department.

OKONITE
TRADE MARK.
Feed Wires.



# on a crowded thoroughfare

where travel is congested, where the clang of gongs din their warnings, and car-men have all they can do to watch incautious pedestrians, aiming to run as near schedule time as possible, what kind of overhead material, trolley wheels, bases, etc., would you recommend?

We hardly admit that the question is open to debate, the only answer we can think of is

**"the very best, gilt-edge, sensible fixtures made."**

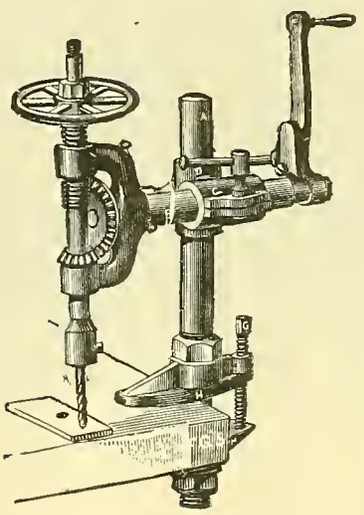
That's the kind we have to sell.

## Good material is cheaper than bad accidents.

(Paste this up for handy reference.)

Our stock of construction material, tools and general supplies for Street Railways, Central Stations and Isolated Plants we believe to be the largest and most complete in the United States. (We are not worrying about the other half of the world.)

**We will be pleased to give our best attention to your orders.**



## Central Electric Company,

**173-175 Adams Street.**

BRANCHES:

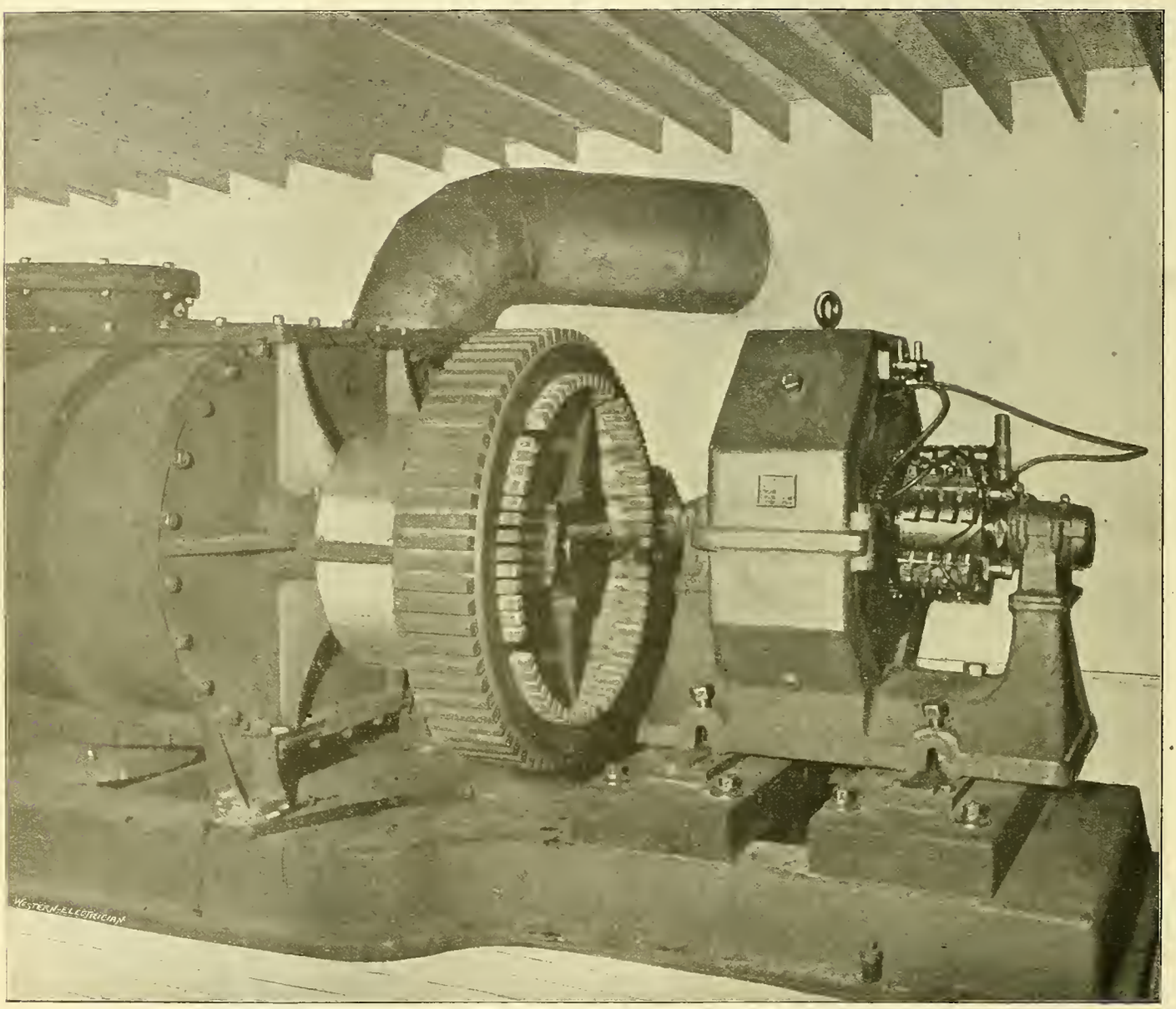
St. Louis; Southern Electrical Supply Co.
Kansas City; Gate City Electric Co.

GENERAL WESTERN AGENTS

Okonite Wires, Interior Conduit Supplies, Helios Arc Lamps, Washington Carbons, Carpenter Enamel Rheostats, Samson Batteries.

# WESTERN ELECTRIC CO.,

## CHICAGO,




WESTERN ELECTRIC MULTIPOLAR MOTOR GEARED DIRECTLY TO ROOT BLOWER.

MANUFACTURERS:

## Arc and Incandescent Electric Lighting Apparatus,

## POWER GENERATORS AND MOTORS,

(BIPOLAR, MEDIUM SPEED. MULTIPOLAR, SLOW SPEED.) Both Slow Speed and Medium Speed.

# A Brand New Arc Lamp.

# THE A.-W. ARC LAMP.

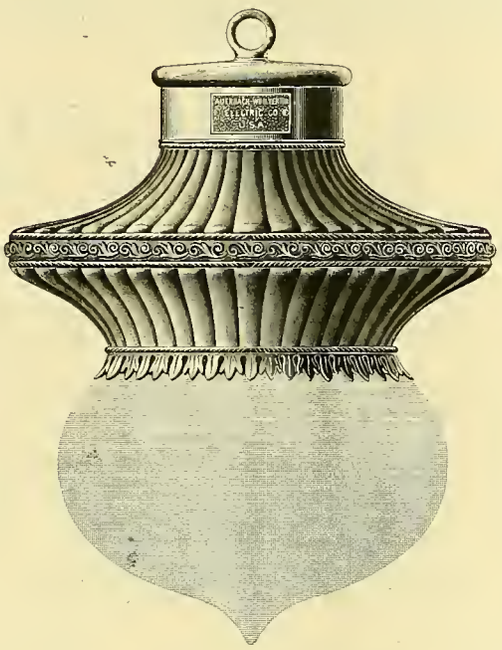
That burns on any current.

That measures 18 inches from top to bottom (including globe).

That has a life of 25 hours in the open air.

That throws light where you want it---on the ground.

That feeds neither by rack, clutch, clockwork, nor chain.



That casts no shadow whatever.

That gives the maximum light distribution.

That gives an absolutely steady light.

That keeps the arc stationary.

That feeds independent of the magnet.

## Simplicity and Durability of Construction.
## The Most Ornamental Lamp in the Market.

# AUERBACH-WOOLVERTON ELECTRIC CO.,

**Cable Building, Houston St. and Broadway,**

## NEW YORK CITY.

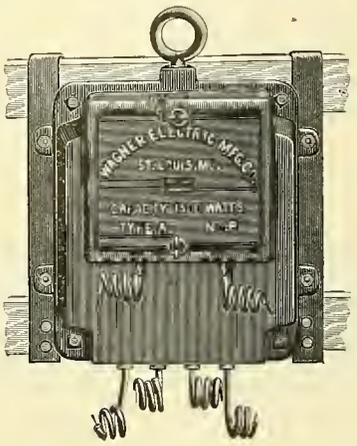
# ALTERNATING CURRENT TRANSFORMERS

Highest Efficiency Ever Obtained.

## TRANSFORMERS

To order for any purpose, voltage or capacity.

**ALTERNATING CURRENT MOTORS.**




Standard Sizes, 5 Lights to 2,000 Lights.

**HIGH POTENTIAL SWITCHES,**

Complete Switch Boards

For Central Stations and Isolated Plants.

## WAGNER ELECTRIC MFG. CO., ST. LOUIS, MO.

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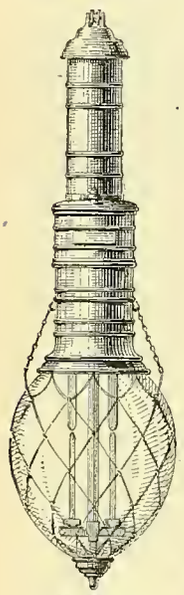


No. 2607 "Twin" Lamp.

# The New "Bergmann" Arc Lamps

**For Constant Potential Circuits.**

**BETTER than all others BECAUSE**

THEY HAVE

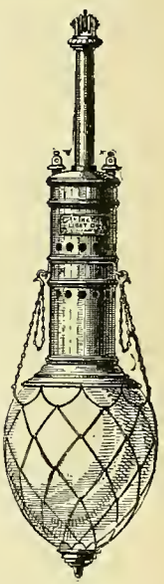
**No Adjusting Springs and No Escapements**

AND CONSEQUENTLY CAN

**Not Get Out of Adjustment or Flicker or Stick.**

**Send for Descriptive Circular of Direct and Alternating Current Lamps, Blade Switches, Imported Carbons, Etc. Prices greatly reduced on everything.**

**THE LATEST IS OUR NEW "TWIN" LAMP.**



No. 2425 A. C. Lamp.

## GENERAL INCANDESCENT ARC LIGHT CO., NEW YORK.

169 Adams Street, CHICAGO. S. BERGMANN, President. 572 to 578 First Ave., NEW YORK.

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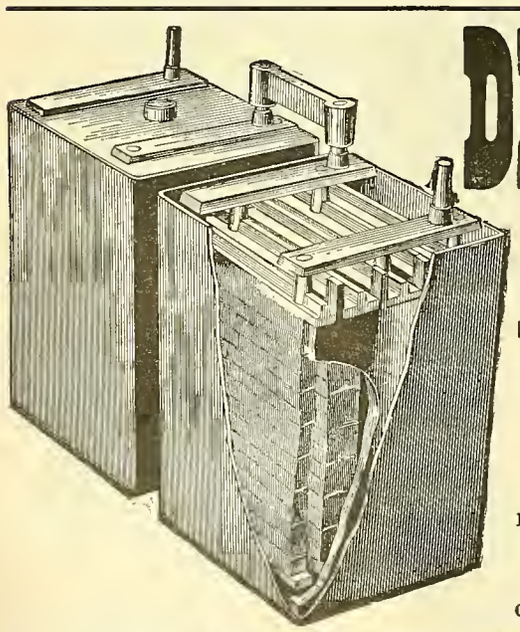

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By all who have used

**STANDARD PLANTÉ BATTERIES.**

Will not **Sulphate** nor **Disintegrate,** and cannot **Buckle.**

**HIGHEST EFFICIENCY, LARGEST DELIVERY, LEAST INTERNAL RESISTANCE.**

**Cells from 10 to 10,000 Ampere-Hour Capacity.**

**CENTRAL STATION INSTALLATIONS.**

Batteries for **Electric Launches,** for **Dental, Surgical** and **Medical Work,** and for all purposes for which electricity is required.

**BATTERIES FOR TRACTION USE.**

Complete Lighting and Power Plants installed as reasonably as consistent with first-class material and workmanship.

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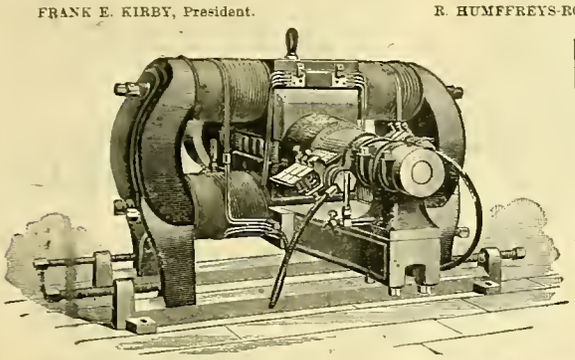
FRANK E. KIRBY, President. R. HUMFFREYS-ROBERTS, Secretary and Manager. RODOLPHUS FULLER, Electrical and Mechanical Engineer.



# FONTAINE CROSSING & ELECTRICAL COMPANY,

MANUFACTURERS OF THE

**FULLER DOUBLE-VOLTAGE DYNAMOS**

(Suitable for any Three-Wire System),

**Fuller Automatic Bi, or Multipolar Dynamos and Motors,**

**Fuller Combination Fan-Motor for Ventilating,**

In sizes from 18 inches to 96 inches diameter.

CHICAGO OFFICE, Dexter Building, 84 Adams St.

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# "The Electra"

# CARBONS.

A highly EFFICIENT and ECONOMICAL Arc Light Service depends on the quality of the Carbons.

**THE BEST QUALITY IS THE CHEAPEST.**

·TRADE MARK·

Highest Award at the World's Columbian Exposition, Chicago, 1893.

## High Grade Nuernberg Carbons

For direct and alternatinng current Arc Lamps, are the most economical and efficient manufactured. They produce a very brilliant and absolutely steady light.

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**HUGO REISINGER,** No. 38 BEAVER STREET, NEW YORK,

Sole Importer for the United States, Canada, Etc.

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# We Want Western Business.

# LA ROCHE ALTERNATORS.

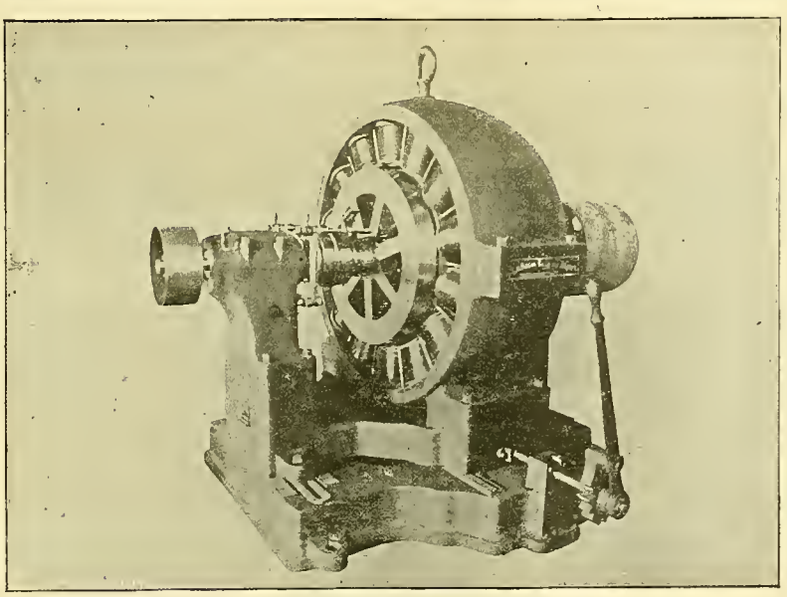
Manufactured in Sizes from

**25 to 5,000 Lights,**

**SINGLE**
OR
**MULTIPHASE.**

**Direct Connected Dynamos.**

**Direct Current Generators.**



1,000 Light Alternator.

**LA ROCHE ELECTRIC WORKS,**

PHILADELPHIA, PA.

DISTRICT OFFICES:

New York, Boston, Knoxville, Cincinnati, Pillsburg, San Francisco, Chicago. St. Louis, Mobile.

**WM. HOOD, 239 La Salle St., Chicago.** **OWEN FORD, Rialto Bldg., St. Louis, Mo.**

# THE C & C ELECTRIC COMPANY

MANUFACTURERS OF

## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

General Office:
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Works: GARWOOD, N. J.
on CENTRAL R. R. of N. J.

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{ CLEVELAND, Cuyahoga Building. PHILADELPHIA, 633 Arch St.

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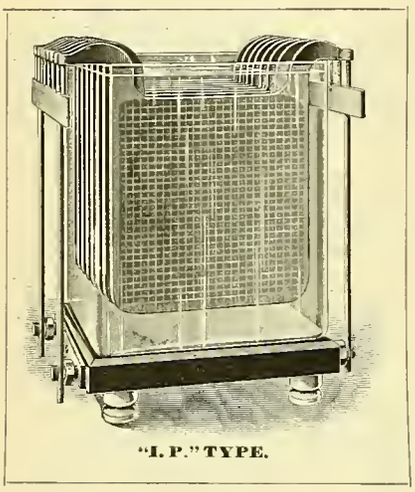

"I. P." TYPE.

## STORAGE BATTERIES
FOR
## CENTRAL STATIONS
SUPPLYING
## LIGHT AND POWER.

New Type with Independent Plates which can be Easily Examined and Replaced without interfering with Charge or Discharge. Capacity from 350 to 12,000 Ampere Hours. No Nuts, Bolts or Screws. Meets all Requirements of Central Stations.

## SPECIAL TYPES FOR VARIOUS PURPOSES.

*STREET CAR TRACTION,*
*ELECTRIC LAUNCHES,*
*YACHT LIGHTING,*

*PHONOGRAPHS,*
*ELECTRO-PLATING,*

*ELECTRIC WELDING,*
*CAUTERY BATTERIES,*
*SAFETY LAMPS.*

For any information regarding types of Cells, weights, dimensions, capacities, prices, discounts, etc., address

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**CANNETT & COMPANY, Schwartz Building, Providence, R. I.**
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**PACIFIC ELECTRICAL STORAGE CO., 118 Pine St., San Francisco, Cal.**

OR

## THE ACCUMULATOR COMPANY, 224 Chestnut St., PHILADELPHIA.

MARO S. CHAPMAN, Pres. THOMAS C. PERKINS, Vice-Pres. JOHN L. BUNCE, Sec'y and Treas. TH. GONET, Supt.

# THE MATHER ELECTRIC COMPANY,
## Manchester, Conn.

**Power Generators for Lighting and Railway Purposes.**
**Complete Station Equipments.**

Mather Apparatus for sale exclusively in their respective territories by the following well-known and reliable Contractors:

## J. HOLT GATES, 1140 Monadnock Building, Chicago, Western Contractor.

**H. B. COHO & CO, 203 Broadway, New York: New York City, Brooklyn and vicinity and New Jersey.**
**G. M. ANGIER & CO., 64 Federal St., Boston, Mass.: New England.**
**S. N. BLAKE, Elmira, New York: Northern and Western New York.**

# "LA MASCOTTE"

Of Perfect Line Insulation and Greatest Earning Capacity.

PARANITE TRADE MARK
WIRES AND CABLES

WEATHER PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES
WIRES AND CABLES

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## Electric Appliance Company,

ELECTRICAL SUPPLIES.

**242 MADISON STREET, CHICAGO.**

GENERAL WESTERN AGENTS

Paranite Wires and Cables, "O. K." Weatherproof Wires and Cables.

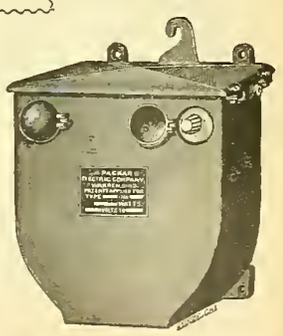
AND REPRESENTING

NEW YORK & OHIO COMPANY, Warren, Ohio,

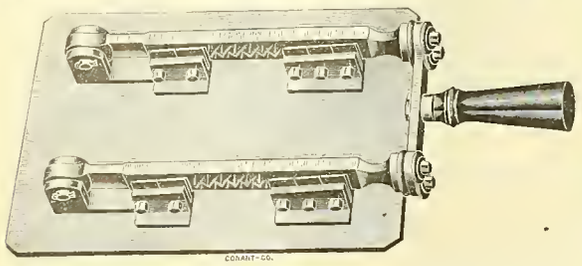
MANUFACTURERS OF THE PACKARD LAMP;

PACKARD ELECTRIC COMPANY, Warren, Ohio,

MANUFACTURERS OF THE PACKARD TRANSFORMER.



# W. S. HILL ELECTRIC CO.



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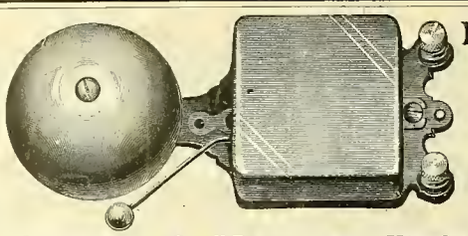

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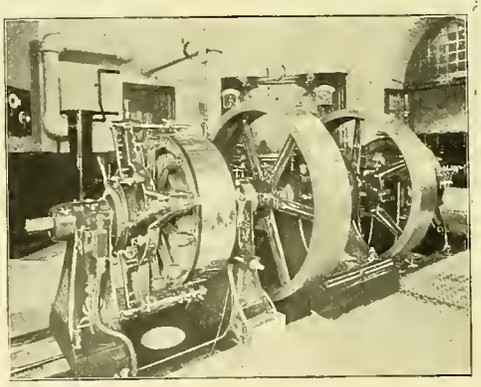

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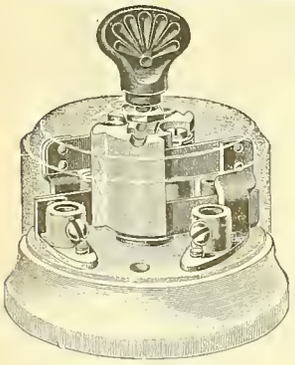

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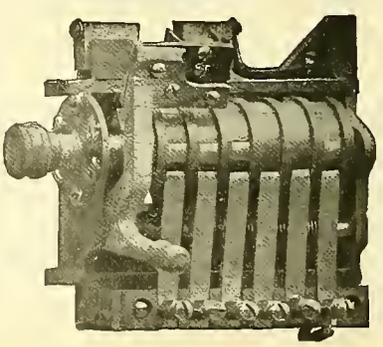

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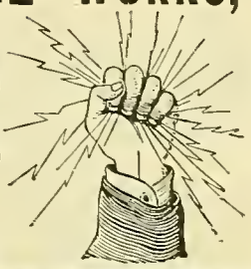

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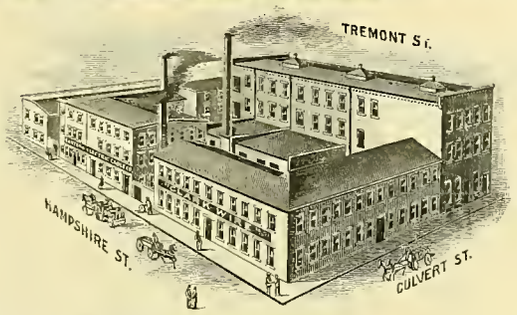


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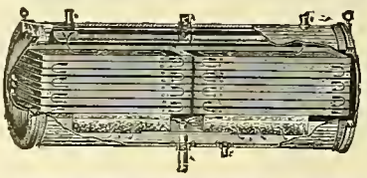

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Notice is hereby given that the undersigned, the assignee for the St. Paul and Minneapolis Messenger and Telephone Company, a corporation, at his office in the Manhattan Building, in the City of St. Paul, Minnesota, on the 14th day of November, A. D. 1894, at 10 o'clock in the morning of said day, will sell to the highest bidder for cash therefor, all the wire, messenger call boxes, batteries, office furniture and fixtures, and all book accounts due to said company. Said sale being made subject to approval by the District Court in and for the County of Ramsey, Minnesota.

Notice is also given that the undersigned will apply to the District Court in and for the County of Ramsey, Minnesota, at a special term of said court, to be held in the City of St. Paul, Minnesota, on the 17th day of November, A. D. 1894, at 10 o'clock in the forenoon on said day or as soon thereafter as counsel can be heard, for an order confirming said sale.

Dated St. Paul, Minn., Oct. 18, 1894.

ROBERT L. WINNE, Assignee.

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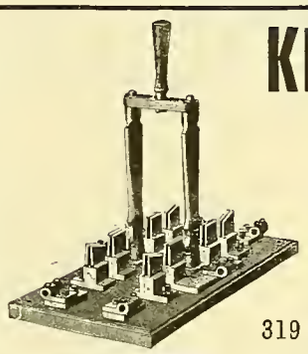

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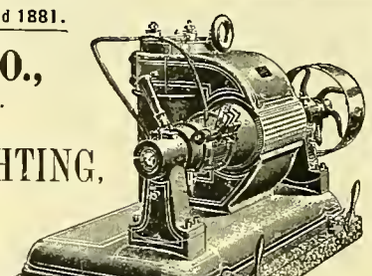

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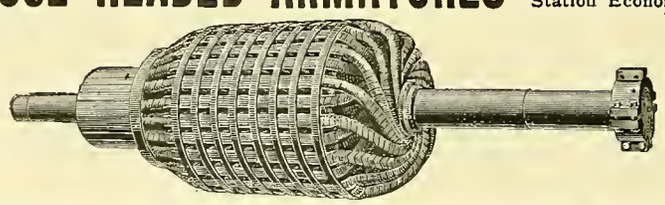

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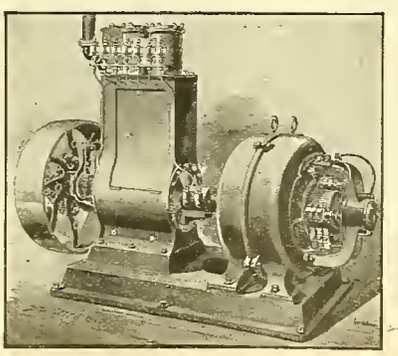

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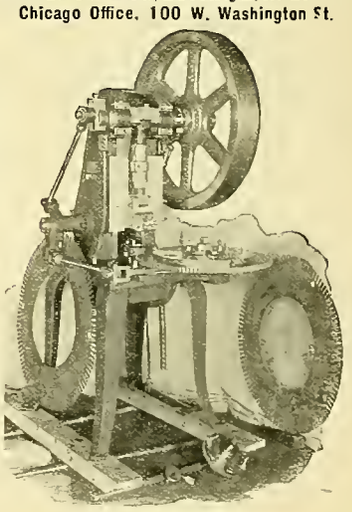

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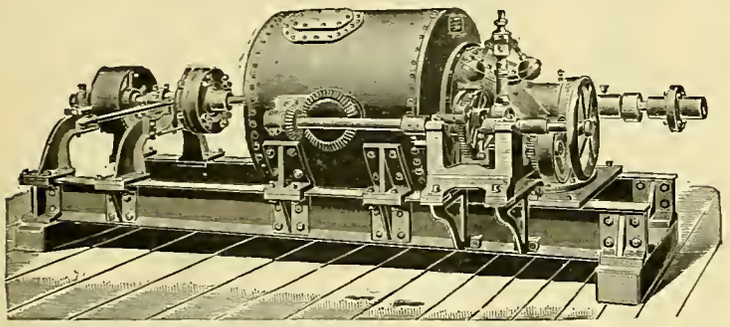

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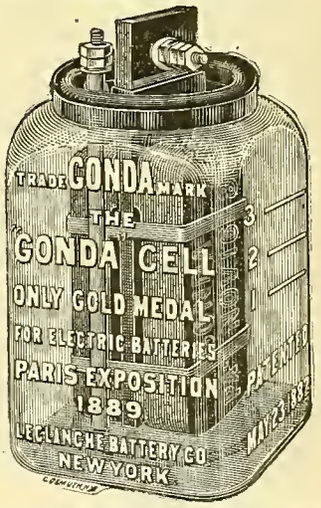


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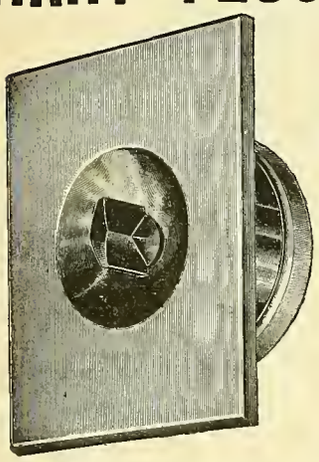

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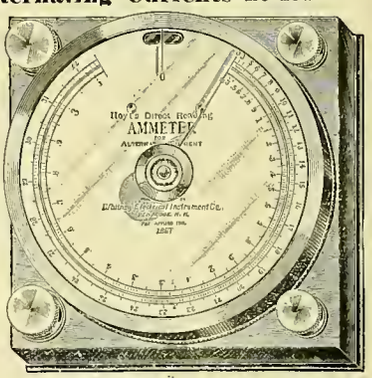


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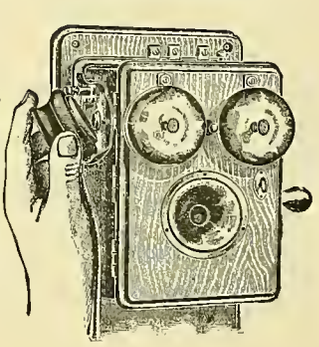

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I find the amount of:

| | | | | | |
|---|---|---|---|---|---|
| Ammonium Chloride | contained | therein | to be | 99.51 | per cent. |
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| Moisture | " | " | " | 0.13 | " |
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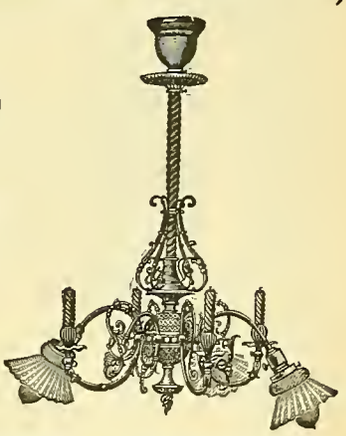

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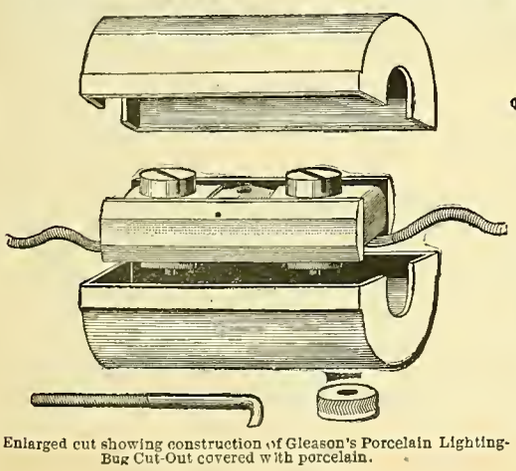

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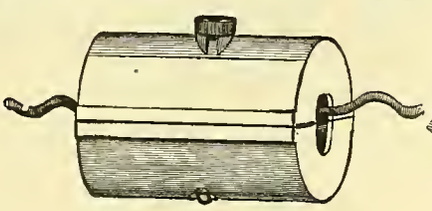

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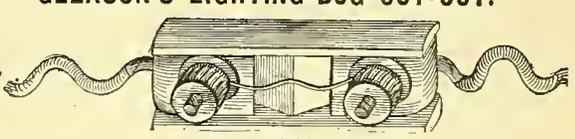

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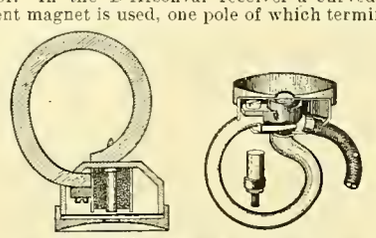
ductor. In the D'Arsonval receiver a curved permanent magnet is used, one pole of which terminates



FIGS. 27 AND 28. D'ARSONVAL RECEIVER.

in a soft iron polepiece that serves as the core of the coil, and the other in an iron box, or cylinder, that

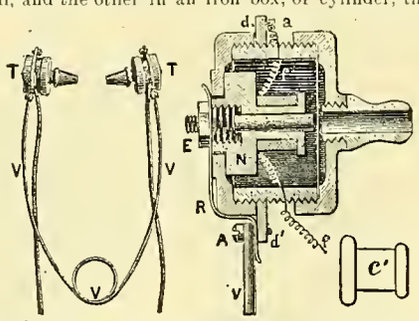



FIG. 29. MERCADIER'S BI-TELEPHONE. *T T* RECEIVERS, *V* SPRING, *N* MAGNET, *E* NUT, *R* STEEL STRIP, *A* SCREW CLAMPING *R* TO *V*, *d d'* METAL COLLAR CLAMPING *V* TO RECEIVER CASE, *f f* TERMINALS OF COIL *a* CONNECTING SCREW, *c'* SOFT RUBBER NIPPLE FOR EARPIECE.

completely encloses the coil. The two poles are magnetically insulated from each other by the wooden case, to the upper part of which the diaphragm is

48 TELEPHONE HAND BOOK.

appeared on the scene with an application for a patent on a microphonic transmitter, and according to the rules of the Patent Office no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbaugh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbaugh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad

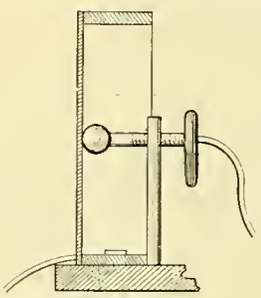


FIG. 44. BERLINER'S FIRST TRANSMITTER.

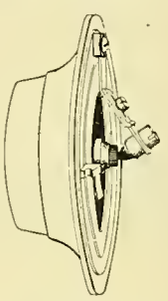


FIG. 45. BERLINER CARBON TRANSMITTER.

principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

78. Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by caus-

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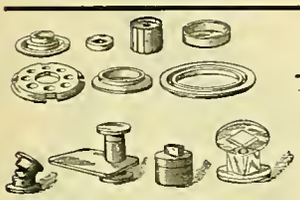

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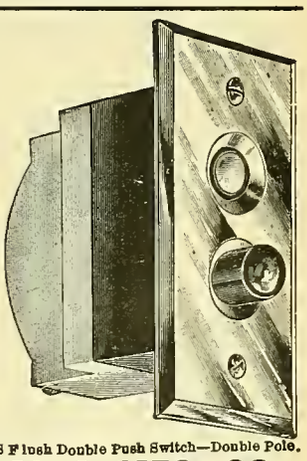

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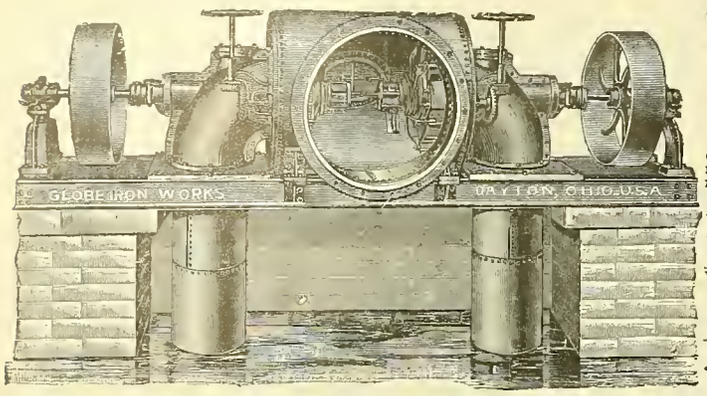


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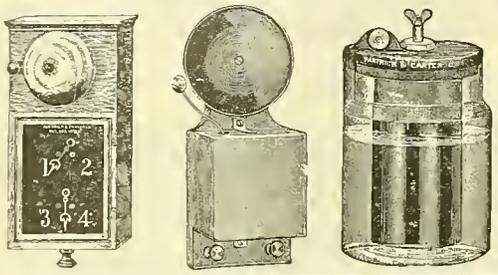

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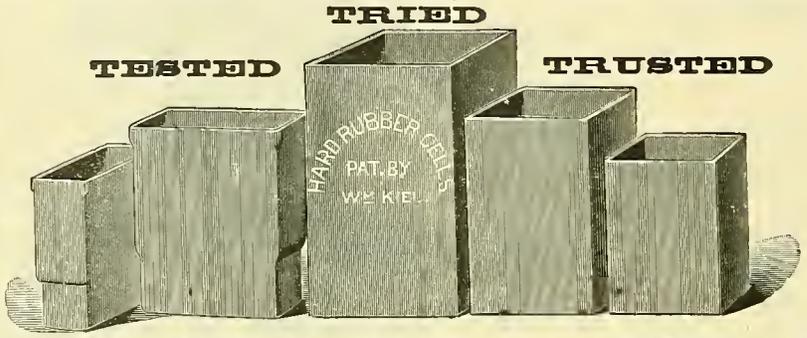


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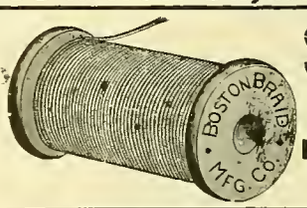


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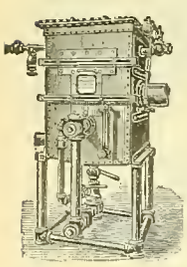

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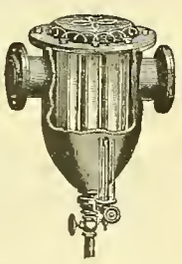

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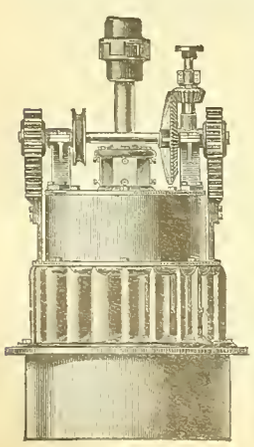

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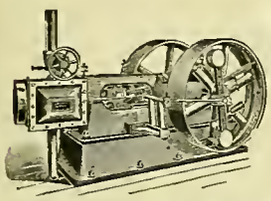

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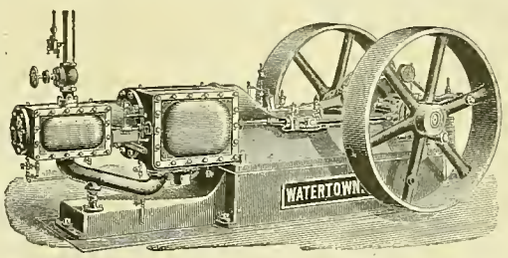


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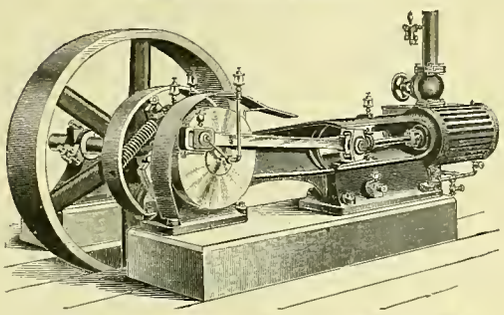

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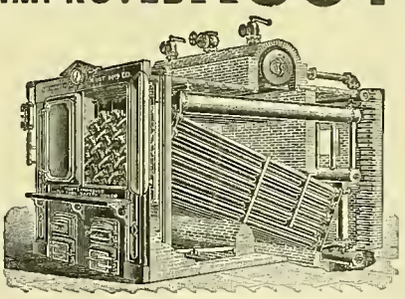

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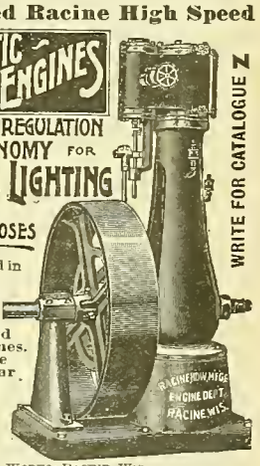


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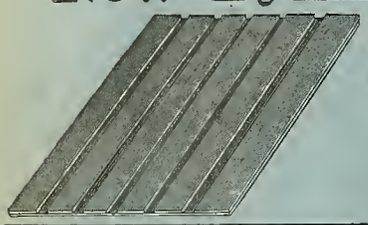

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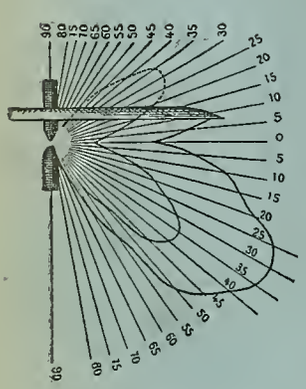

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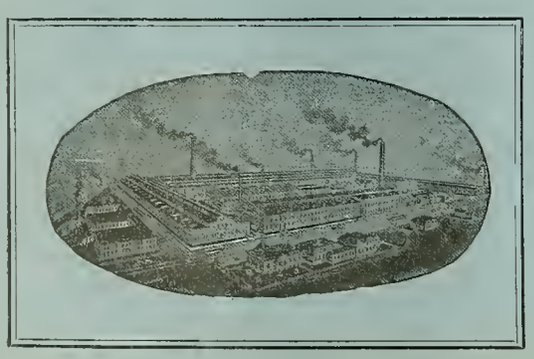

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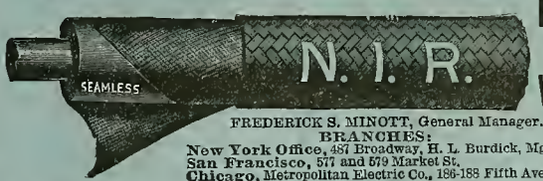


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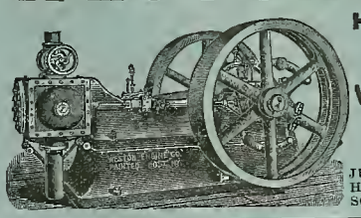

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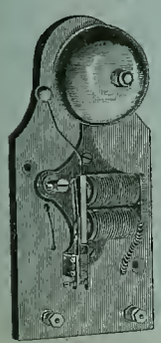

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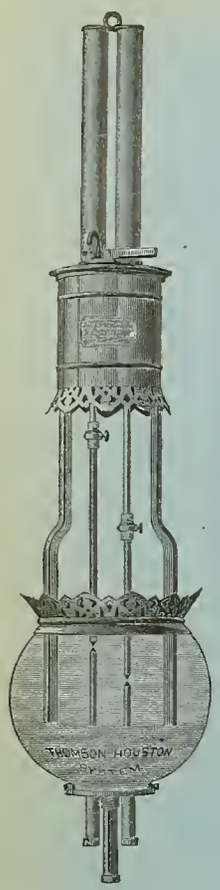


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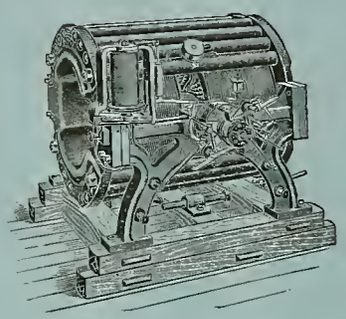

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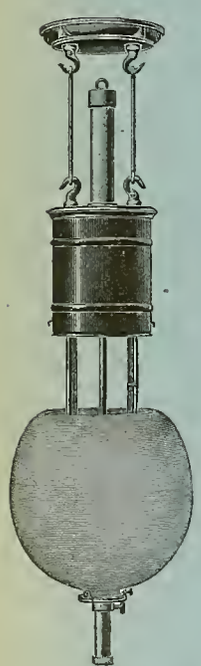

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## CLASSIFIED LIST.


**Accumulators.**
Accumulator Co.
Boswell & Co., D. E.,
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

**Annunciators.**
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Buebel & Manger.
Ostrander & Co., W. R.
Partrick & Carter Co.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
Auerbach-Woolverton El. Co.
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Arc Light Cord.**
Samson Cordage Wks.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Central Electric Co.
Electric Appliance Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Hayden-Booker Mfg. Co.
Law Battery Co.
Leclanche Battery Co., The.
Miamisburg Electric Co.
Partrick & Carter Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Central Electric Co.
Electric Appliance Co.
Buebel & Manger.
Ostrander & Co., W. R.
Western Electric Co.

**Belting.**
Shultz Belting Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co, The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electrician Publishing Co.

**Brushes.**
Partridge Carbon Co.

**Burglar Alarms.**
Central Electric Co.
Electric Appliance Co.
Partrick & Carter Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric.** (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Cushing & Morse.
Eastern Electric Cable Co.
Hill, W. S. Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons, Points & Plates.**
Central Electric Co.
General Electric Co.
Partridge Carbon Co.
Reisinger, Hugo.
Western Electric Co.

**Car-Heaters, Electric.**
Consolidated Car-Heating Co.

**Clocks, Electric.**
Self-Winding Clock Co.

**Conduits**
Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Bussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Muncie Elec. Mfg. Co.
Washington Electric Co.

**Contractors and Electric Light Plants.**
Allen-Bussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co
Muncie Elec. Mfg. Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Mismisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
National India Rubber Co.
Okonite Co. The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cordage.**
Samson Cordage Wks.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Central Electric Co.
Electric Appliance Co.
Nuttall Co., R. D.
Partrick & Carter Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

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Fuel Economizer Co.

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Consolidated Car Heating Co.

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Brush Electric Co.
General Electric Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Bussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. B.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Rushmore, S. W.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Diamond Electric Co.
Electric Appliance Co.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Large & Twining.
Nuttall Co., R. D.
Partrick & Carter Co
Sweet Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.

**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Gas.**
Webster Mfg. Co.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Engravers.**
Illinois Engraving Co.

**Fan outfits.**
Bolgiano Mfg. Co.
Central Electric Co.
Interior Conduit & Ins. Co.
Muncie Elec. Mfg Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Partrick & Carter Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. Supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
High & Co., J. Grant.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Palmer Bros.
Partrick & Carter Co.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Induction Coils.**
Splitdorf, C. F.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Hill, W. S. Electric Co.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Technic Electrical Wks.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Central Electric Co.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Large & Twining.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Central Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Mather Electric Co.
New York & Onio Co.
Partrick & Carter Co.
United Elec. Imp. Co.
Westinghouse Elec. & Mfg. Co.

**Lightning Arresters.**
Central Electric Co.
Diamond Electric Co.
Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery.**
Bliss Co., E. W.
Hine & Robertson Co.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

**Motors.**
Bolgiano Mfg. Co.
Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Royal Electric Co.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co

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Garlock Packing Co.

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Standard Paint Co.

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Gooch, Chas. J.

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Phosphor Bronze Sm. Co. Ltd

**Platinum.**
Baker & Co.

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Brownlee & Co.
Morris, Tasker & Co.
Nuttall Co., R. D.

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Empire China Works.
General Electric Co.
Phœnix Glass Co.

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Electrician Publishing Co.

**Push Buttons.**
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Electric Appliance Co.
Huebel & Manger.
Partrick & Carter Co.

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Rushmore, S. W.

**Sal Ammoniac.**
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Klipstein, A. & Co.
Law Battery Co

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Rushmore S. W.

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Goubert Mfg. Co.
Hine & Robertson Co.

**Silk Braid.**
Boston Braid Mfg. Co.

**Slate.**
Independent Electric Co.

**Speaking Tubes.**
Central Electric Co.
Electric Appliance Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

**Speed Indicators.**
Diamond Electric Co.
Whitney Elec. Instrument Co.

**Steam Heating.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Steam Pumps.**
Worthington, Henry R.

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Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

**Street Cars.**
Brill, J. G. Co.

**Tapes, Insulating.**
American Electrical Works.
Central Electric Co.
Cushing & Morse.
Electric Appliance Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
Central Electric Co.
Electric Appliance Co.
Partrick & Carter Co.
Western Electric Co.

**Telephones.**
D'Unger Long Dist. Tel. Co.
National Telep. Mfg. Co.
Palmer Bros.
Partrick & Carter Co.
Western Electric Co.
Western Tel. Const. Co.

**Telephone Hooks.**
Bradley & Co.

**Transformers.**
Diamond Electric Co.
General Electric Co.
Hornberger Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Trolley Cord.**
Samson Cordage Wks.

**Trucks, Electric Car.**
General Electric Co.
Westinghouse El. & Mfg. Co.

**Turbine Wheels.**
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

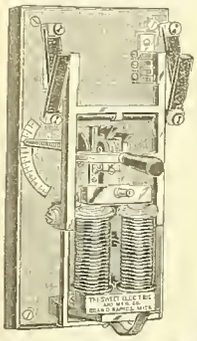
**Universities.**
Cor. School of Industrial Sciences.
Scientific Machinist Co.

**Varnishes.**
Standard Paint Co.

**Water Wheels.**
Leffel & Co., Jas.
Smith, S. Morgan.

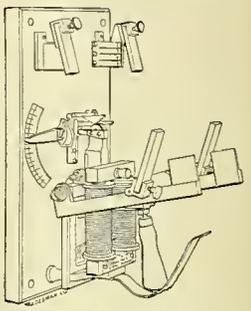
**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Central Electric Co.
Electric Appliance Co.
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.

# HAVE PATIENCE!



We will answer every one who has written to us for information regarding our

## LIMIT SWITCH.



We knew that every one having electrical apparatus needed one or more of our Circuit Breakers, or we would not have started to manufacture them, but we did not anticipate the fact that there was the demand for them that there is. But electrical people are not slow to catch on to a good thing when they see it.

Write us and see what we can do for you.

## SWEET ELECTRIC & MFG. CO.,

GRAND RAPIDS, MICH.

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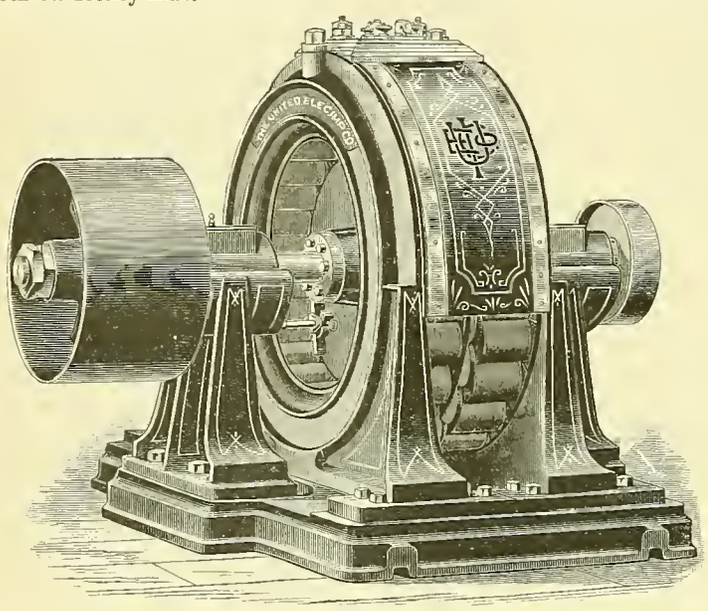

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## The United Electric Improvement Co.,

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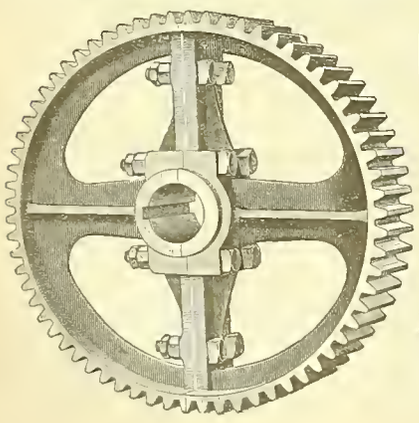
J. R. McGINLEY, Vice-President.
F. S. MARTIN, Superintendent of Works.



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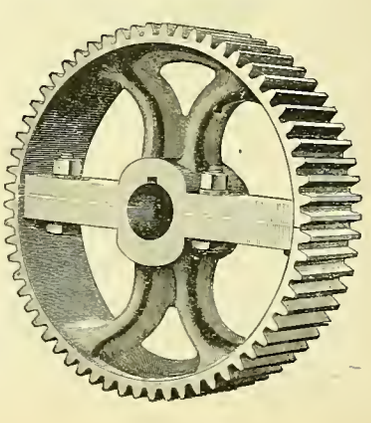

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STANDARD R'Y SUPPLY CO., Monadnock Block, Chicago, Ill., N. W. States Sales Department.
A. S. PARTRIDGE, Bank of Commerce Building, St. Louis, Mo., S. W. States Sales Department.
CHAS. A. CAVAGNA, Neave Building, Cincinnati, Ohio, Central States Sales Department.

a c...
...is bears.
...is quite ... to meet him befo...
...nonest men at any time and submit its ...
...ention to their judgment.

### THE RACE BETWEEN CHICAGO AND NEW YORK

The New York *World* is truthful and conscientious enough to admit that at last Chicago has beaten New York in the contest for first rank in voters and population. In other words, it admits that Chicago is the metropolis of the United States and that New York takes second place. After making the admission it tenders its congratulations in the following graceful fashion:

That Chicago has achieved this result by consolidating the territory and population that naturally belongs to it does not detract from its credit. That the greater Chicago is bigger than the smaller New York is a reflection upon our sagacity, public spirit, and enterprise, not a reflection upon the methods of the mighty metropolis of the West. Upon the basis of this year's registration the newspapers of Chicago claim a population of 2,175,732. This is indeed a marvelous showing. It is one of which all Americans have reason to be proud, even as they were proud of that greatest and most beautiful of Chicago's achievements, the White City of the World's Fair.

The only way out of this predicament is now being canvassed by the excited New-Yorkers. It contemplates the annexation of Brooklyn and other outlying areas. It is questionable, however, whether Brooklyn will be in a hurry to be absorbed by its neighbor across the big bridge. The Brooklynites know well enough that it would only put off the question of supremacy for a short time. They have no overweening desire to sacrifice themselves and lose their municipal identity for the glorification of New York. They know well enough it is useless to conceal the fact that Chicago is destined to be the London of America, of which New York will be the highly respectable Liverpool. New York will be the port for Chicago, and Chicago will be the great central point to which Denver, Pittsburg, St. Louis, Louisville, Cleveland, Minneapolis, St. Paul, and other feeders will send their goods for sale. The agricultural products of the great West must come here. Chicago will be the great manufacturing center, thus still further increasing its great population. Its factories and shops will be hives of industry, swarming with thousands of workingmen. It will be the great railroad center of the continent. As the most accessible point in the country thousands will be attracted here by the extraordinary inducements offered them. All these influences will tend not only to a phenomenal increase of population, but to a corresponding increase of wealth. Hence it must be the commercial, industrial, and financial center of America. The New-Yorkers feel this, but nothing can tempt them to admit it. The Brooklynites know it. Meanwhile Chicago is contented with the situation. It knows that it is today the metropolis of the United States, but it is not proud or vainglorious on that account, nor is it inclined to exalt itself at the expense of New York. It harbors no jealousies and cherishes no envy of the late metropolis. It even hopes that the New-Yorkers may annex all that they want, so that Chicago may have a good, fair and square race with that city. The outcome of such a race is inevitable.

### POPULIST CANDIDATES FOR CONGRESS.

Following are the names of the Populist candidates for Congress in this county, and ...e great question of protec-


**Doing business in the metropolis of the United States,** we are enabled to secure advantages for our customers in many ways not possible with establishments in smaller cities.

The railway and shipping facilities of Chicago are unsurpassed; all influences are in the direction of the rapid transaction of business.

Not alone in manufacturing and financial interests will Chicago lead, but also in the manufacture and distribution of Electrical Supplies. To this central point the great Electric Railway Systems of the country, the marvelous Power Plants, the thriving Central Stations in every city, village and hamlet, must look for their general supplies.

We congratulate ourselves that we are early in the field, that we are **already here.** We recognize the advantages under which we labor and we are ready to share with you.

**What we want is orders.**

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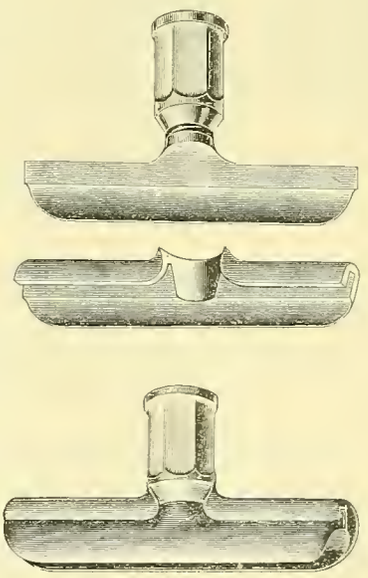
This new Trolley Wire Clamp is made to fit either a $\frac{5}{8}$ in. or $\frac{7}{16}$ in. stud. We furnish them in bronze or malleable iron. They hold the wire with a grip that nothing in the way of a strain can loosen. They offer no obstruction to the passage of the wheel, hence no jumping or sparking. No bolts or screws.



# Central Electric Company,

**173-175 Adams St., CHICAGO.**

BRANCHES:

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Kansas City: Gate City Electric Co.

GENERAL WESTERN AGENTS

Okonite Wires, Interior Conduit Supplies, Helios Arc Lamps, Washington Carbons, Carpenter Enamel Rheostats, Samson Batteries.

# THE HELIOS

## New Alternating Arc Lamp

### For Street Lighting

No. 10.
Street Lamp, either 12 or 14 hour, to be used in connection with Special 33 Volt Transformer.

New Alternating Lamp 900 c. p, 7 amperes at 28 volts or 4½ amperes at 50 volts, 2¼ amperes at 100 volts. It consumes the energy of 3½ 16 c. p. incandescent lamps. A small alternating lamp is only possible with a reflector plate.

## *Low Potential Direct Current Lamps*

We have just completed a new direct current lamp which we guarantee will not **SEE-SAW.** The mechanism is entirely novel. By means of this arrangement the most troublesome feature in running lamps in series is eliminated.

No. 13.
Inside 7 Ampere 7 Hour Lamp.

Write us for Prices and Discounts

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*PHILADELPHIA, PA.*

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Southwestern Agents: ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis, Mo.
New York City Agents: GLOBE ELECTRICAL SUPPLY & CONSTRUCTION CO., Vandam and Greenwich Streets.
MOUNTAIN ELECTRIC CO., Denver, Col., Agents for Colorado, Utah, Wyoming and New Mexico.
MACHINERY SUPPLY CO., Los Angeles, Cal., Agents for Lower California and Arizona.
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# We Want Western Business.

# LA ROCHE ALTERNATORS.

Manufactured in Sizes from

**25 to 5,000 Lights,**

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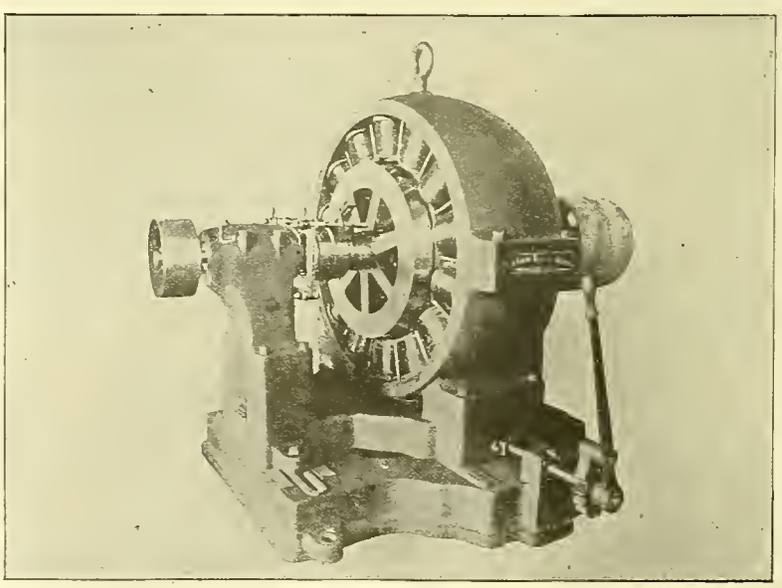
OR
**MULTIPHASE.**

Direct Connected Dynamos.

Direct Current Generators



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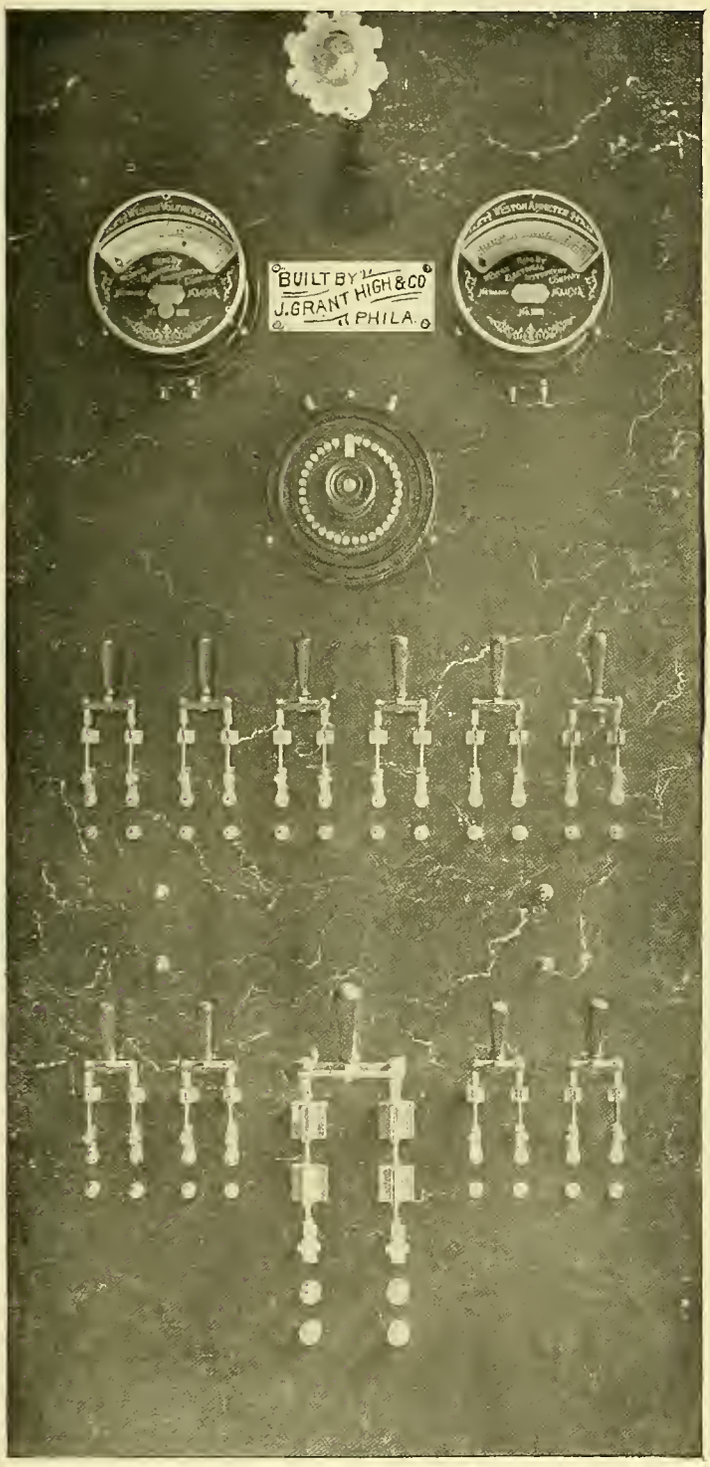


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AND
## MAIN LINE CUT-OUTS.

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To order for any purpose, voltage or capacity.

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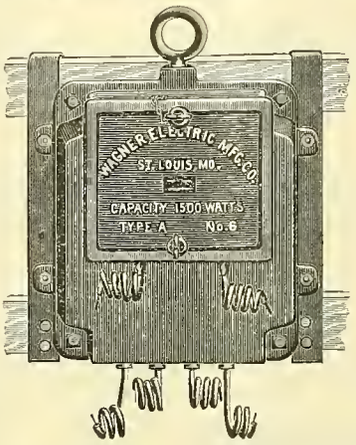


• Standard Sizes, 5 Lights to 2,000 Lights.

**HIGH POTENTIAL SWITCHES,**

Complete Switch Boards

For Central Stations and Isolated Plants.

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# New York Insulated Wire Co.,

**Sole Manufacturers,**

Grimshaw White Core and Raven Core Wires, Grimshaw Underground Lead Covered Cables,
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Vulca Bushings, all sizes, Vulca Electrical Wire Ducts for Interior Construction.

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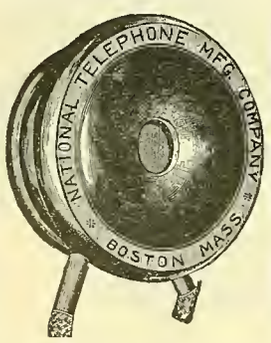
The most Powerful Receiver Known—Patented May 29, 1894.

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We make simply a business proposition. Buy two sets of our instruments and make your own tests. If satisfactory the way is open for more business, either in telephones or switchboards for exchanges.

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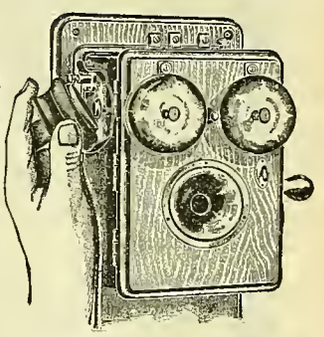

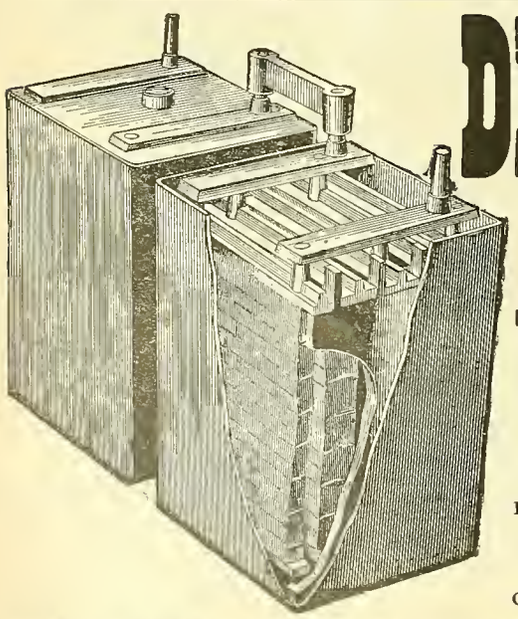

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Batteries for **Electric Launches,** for **Dental, Surgical** and **Medical Work,** and for all purposes for which electricity is required.

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## STORAGE BATTERIES FOR CENTRAL STATIONS SUPPLYING LIGHT AND POWER.

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# THE A.-W. ARC LAMP.

That burns on any current.

That measures 18 inches from top to bottom (including globe).

That has a life of 25 hours in the open air.

That throws light where you want it—on the ground.

That feeds neither by rack, clutch, clockwork, nor chain.

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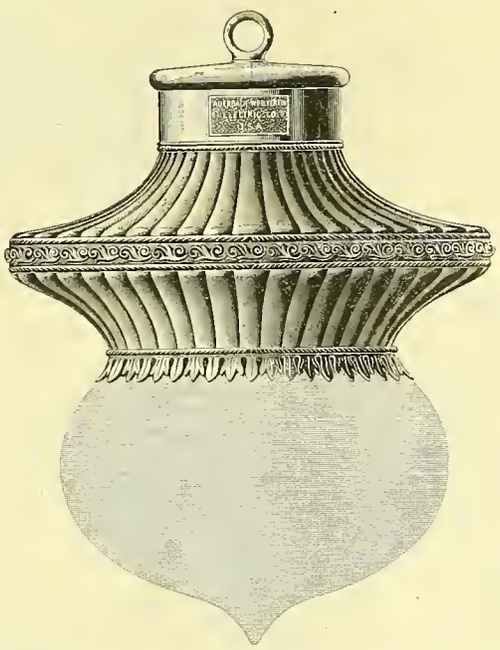

That gives the maximum light distribution.

That gives an absolutely steady light.

That keeps the arc stationary.

That feeds independent of the magnet.

**SIMPLICITY AND DURABILITY OF CONSTRUCTION.**

**THE MOST ORNAMENTAL LAMP IN THE MARKET.**

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"O. K." Weatherproof Wire, which is now the universally accepted standard of weatherproof insulation. Remember us also on

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Switch-Boards.
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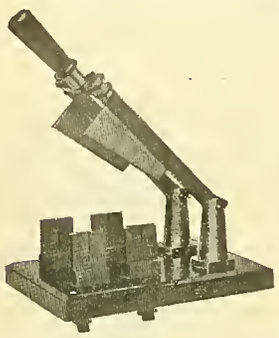

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Charges reasonable for superior work.
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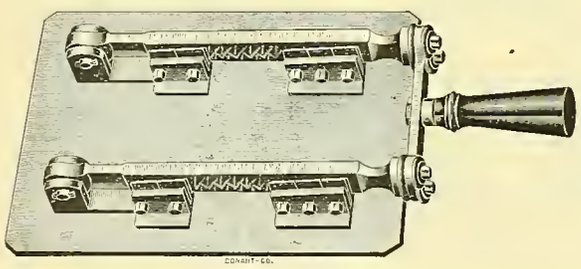

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For Arc Light and Trolley Cord.
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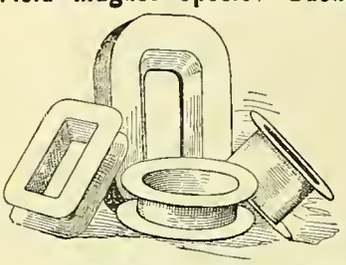

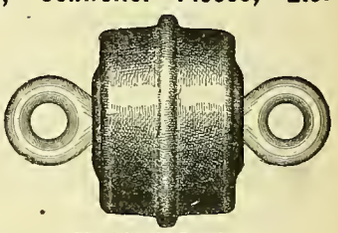

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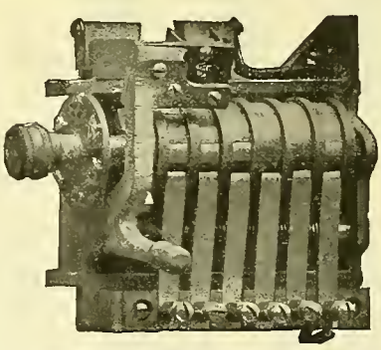

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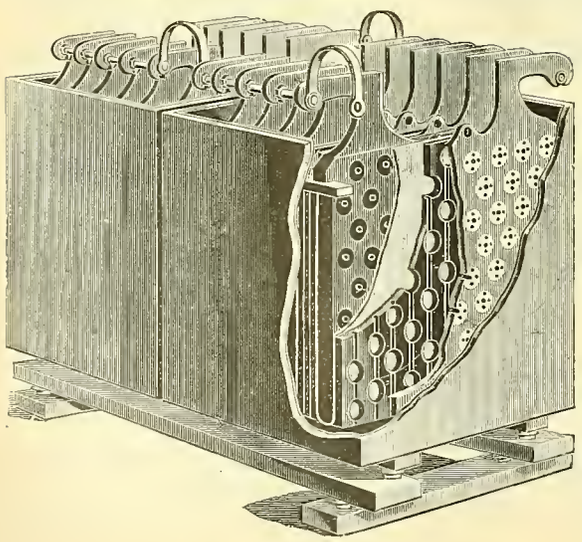

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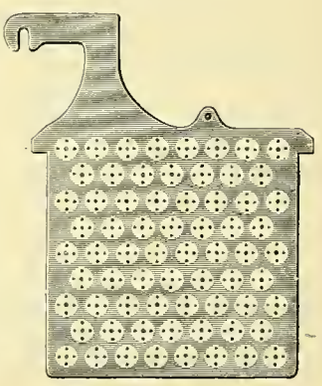

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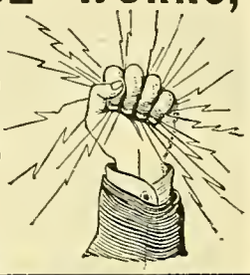

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This company is manufacturing

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which it sells outright under a guarantee both as to efficiency and as against infringement of patents.

It talks as well over one hundred miles as any other Telephone talks over one mile.

This company is also prepared to fully equip Telephone exchanges, (furnishing everything from the telephone to the wire and poles). Private lines, Factory plants, etc., and do all kinds of construction work.

Send for circulars and price lists.

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For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

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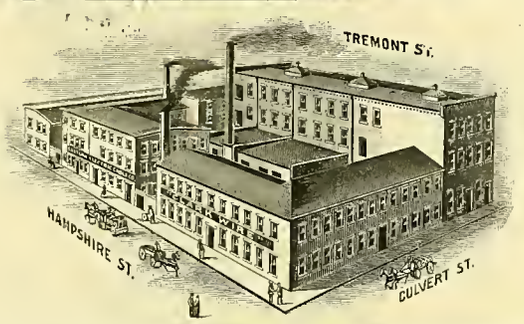


**In a Letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A Thoroughly Reliable and Desirable Wire in every respect."**

The Rubber used in insulating our Wires and Cables is especially chemically prepared, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat.

We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first class Insulated Wire.

We shall be pleased to mail Catalogues with Terms and Discounts for Quantities.

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## The Most Reliable ALTERNATING System now on the Market.

**OUR ALTERNATOR HAS:**

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**Step Down TRANSFORMERS.** **Step Up TRANSFORMERS.**

TRANSFORMERS for any desired Voltage. Arc Light TRANSFORMERS. Direct Current Generators and Motors.

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# "IDEAL" INSULATED COPPER WIRE.

**Approved by the New York Board of Fire Underwriters.**

The Only Authorized FIBRE COVERED WIRE for INSIDE, TUBE and CONCEALED WORK GENERALLY.

**It will not Deteriorate by long use, nor Oxidize the Copper. Finished in the following Styles: Black Polished, White and Black Glazed Braid and White Fireproof.**

We can freely recommend this Wire for all inside wiring, from the fact that recent insulation tests made by reliable authorities show that it stands very high.

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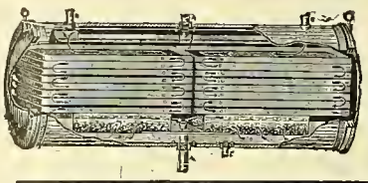

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Notice is also given that the undersigned will apply to the District Court in and for the County of Ramsey, Minnesota, at a special term of said court, to be held in the City of St. Paul, Minnesota, on the 17th day of November, A. D. 1894, at 10 o'clock in the forenoon on said day or as soon thereafter as counsel can be heard, for an order confirming said sale.

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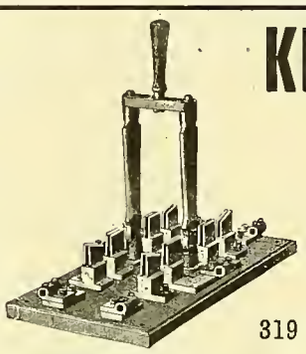

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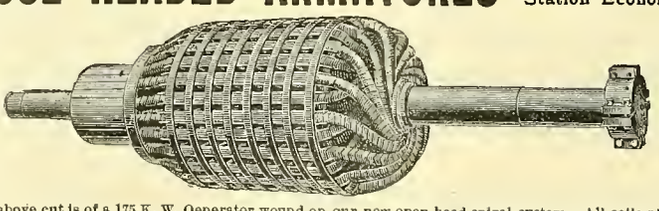

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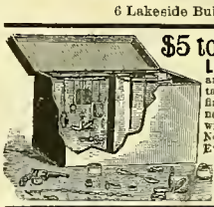

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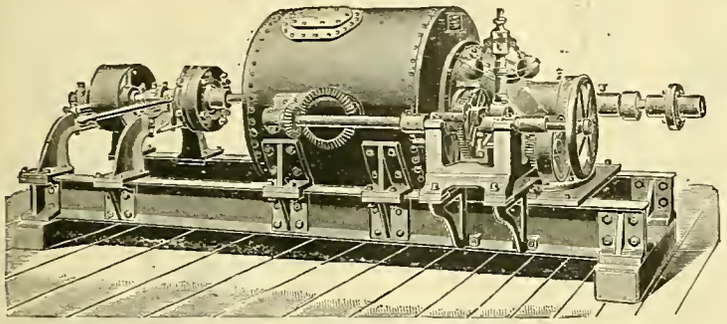

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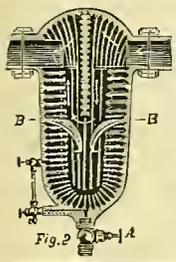


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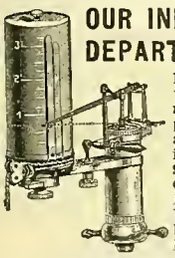

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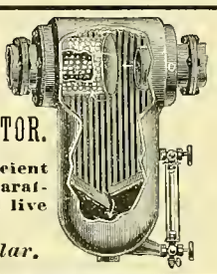

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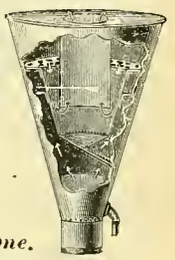

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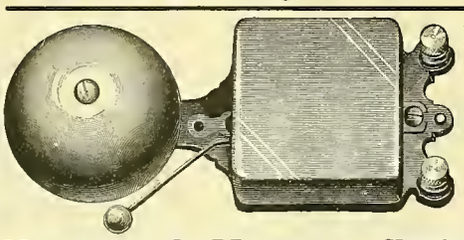

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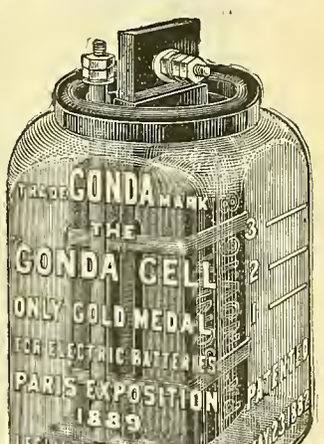


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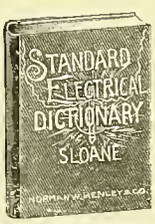

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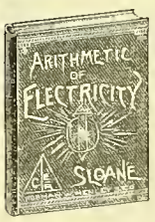

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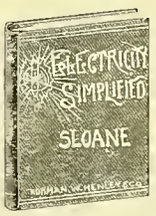

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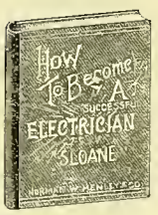

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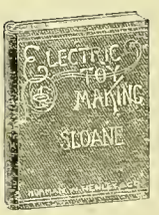

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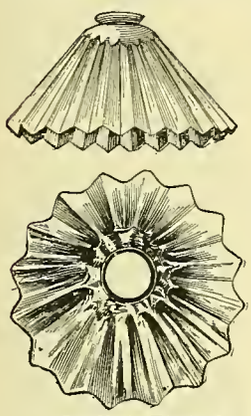

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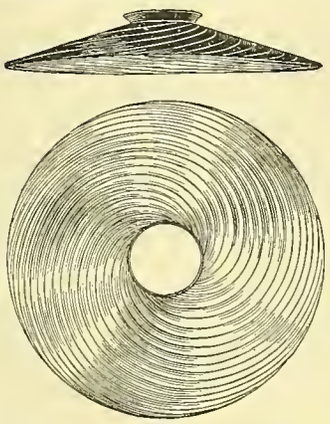

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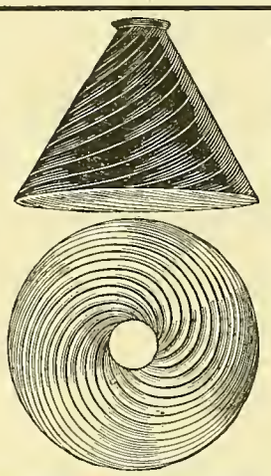

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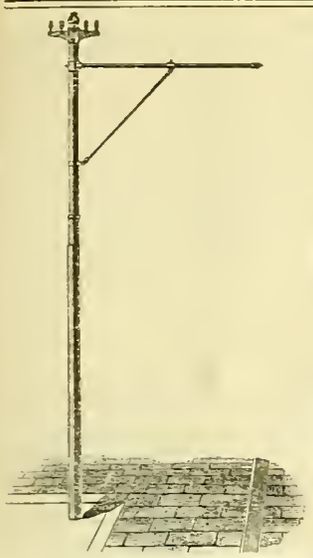

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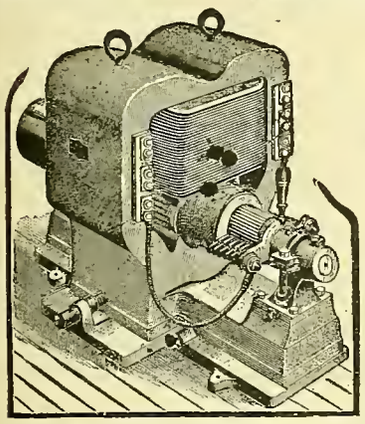

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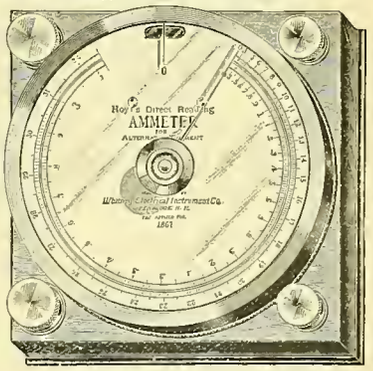


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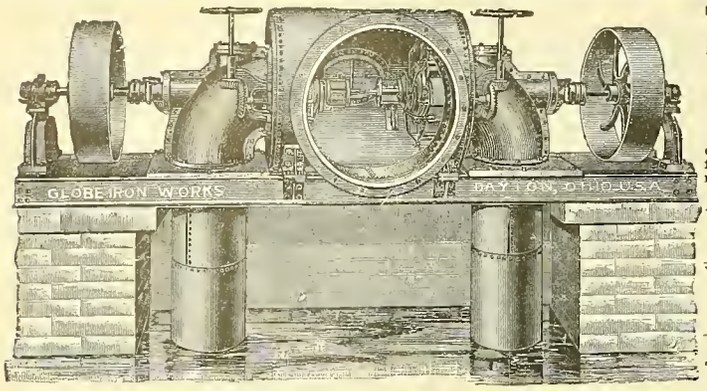


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**Test of a 45 inch Wheel—July 9, 1894.**

| | Head. | Rev. per Min. | Cu. Ft. per Sec. | Horse Power. | P'r Cent |
|---|---|---|---|---|---|
| Whole Gate | 16.06 | 119.17 | 141.68 | 205.27 | 79 76 |
| ¾ " | 16.42 | 122.00 | 127.18 | 195 19 | 82.58 |
| ½ " | 16.78 | 117.33 | 112 60 | 175 74 | 82.18 |
| ¼ " | 17.03 | 111.83 | 98,12 | 149.99 | 79.31 |
| ⅛ " | 16.88 | 118.67 | 82.17 | 1 8 40 | 75.52 |

**Test of a 42-inch Wheel—July 14, 1894.**

| | Head. | Rev. per Min. | Cu. Ft. per Sec. | Horse Power. | P'r Cent |
|---|---|---|---|---|---|
| Whole Gate | 16.33 | 128.00 | 134.18 | 199.56 | 80.50 |
| ¾ " | 16.66 | 134.80 | 120.85 | 188.14 | 83.09 |
| ½ " | 16.59 | 129.33 | 104.85 | 162.89 | 82.77 |
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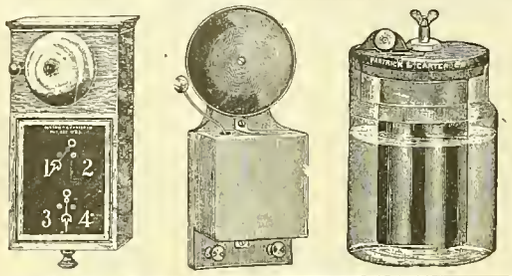

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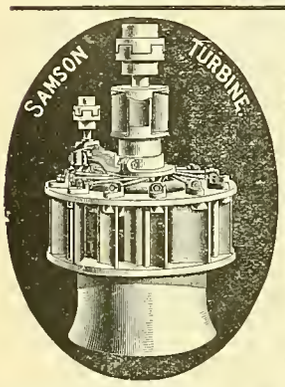


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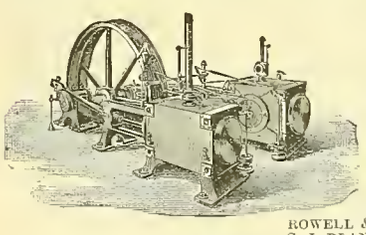

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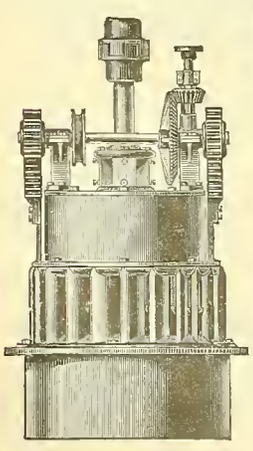

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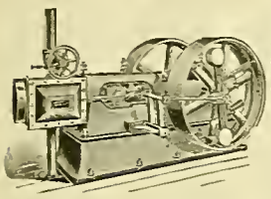

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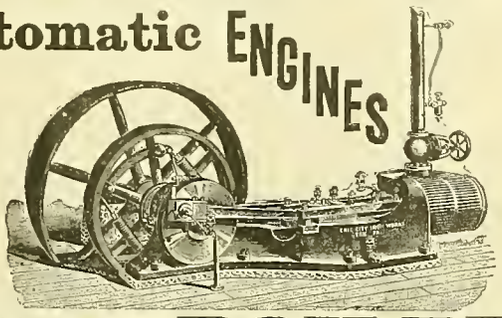

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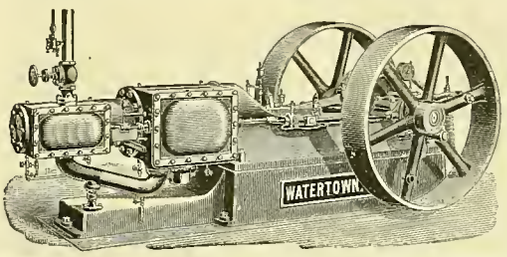


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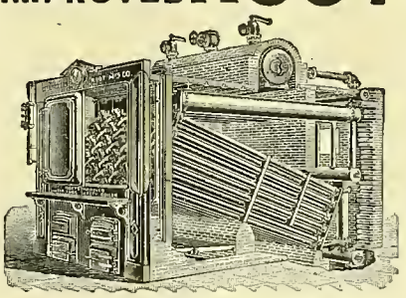

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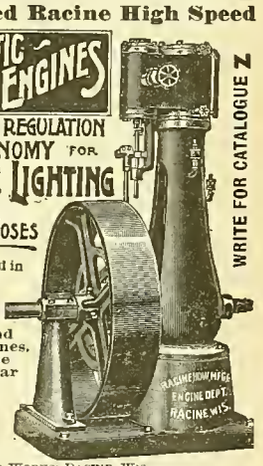

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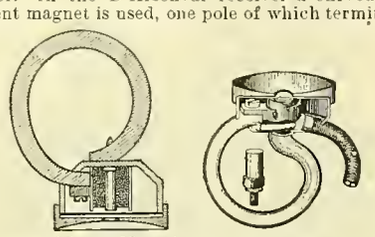
ductor. In the D'Arsonval receiver a curved permanent magnet is used, one pole of which terminates



FIGS. 27 AND 28. D'ARSONVAL RECEIVER.

in a soft iron polepiece that serves as the core of the coil, and the other in an iron box, or cylinder, that

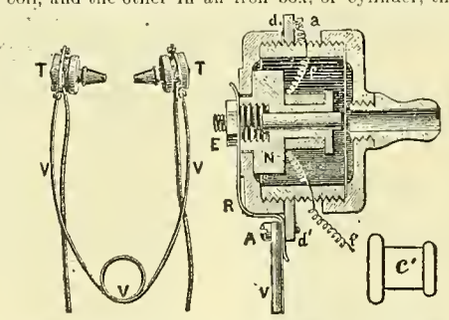



FIG. 29. MERCADIER'S BI-TELEPHONE. *T T* RECEIVERS, *V* SPRING, *N* MAGNET, *E* NUT, *R* STEEL STRIP, *A* SCREW CLAMPING *R* TO *V*, *d d'* METAL COLLAR CLAMPING *V* TO RECEIVER CASE, *f f* TERMINALS OF COIL *a* CONNECTING SCREW, *c'* SOFT RUBBER NIPPLE FOR EARPIECE.

completely encloses the coil. The two poles are magnetically insulated from each other by the wooden case, to the upper part of which the diaphragm is

48 TELEPHONE HAND BOOK.

appeared on the scene with an application for a patent on a microphonic transmitter, and according to the rules of the Patent Office no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbaugh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbaugh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad

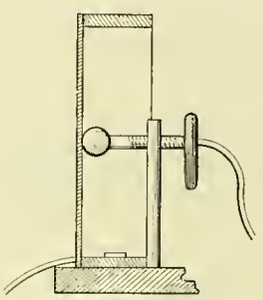


FIG. 44. BERLINER'S FIRST TRANSMITTER.

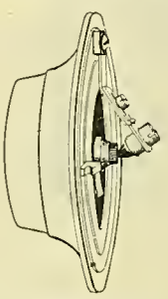


FIG. 45. BERLINER CARBON TRANSMITTER.

principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

78. Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by caus-

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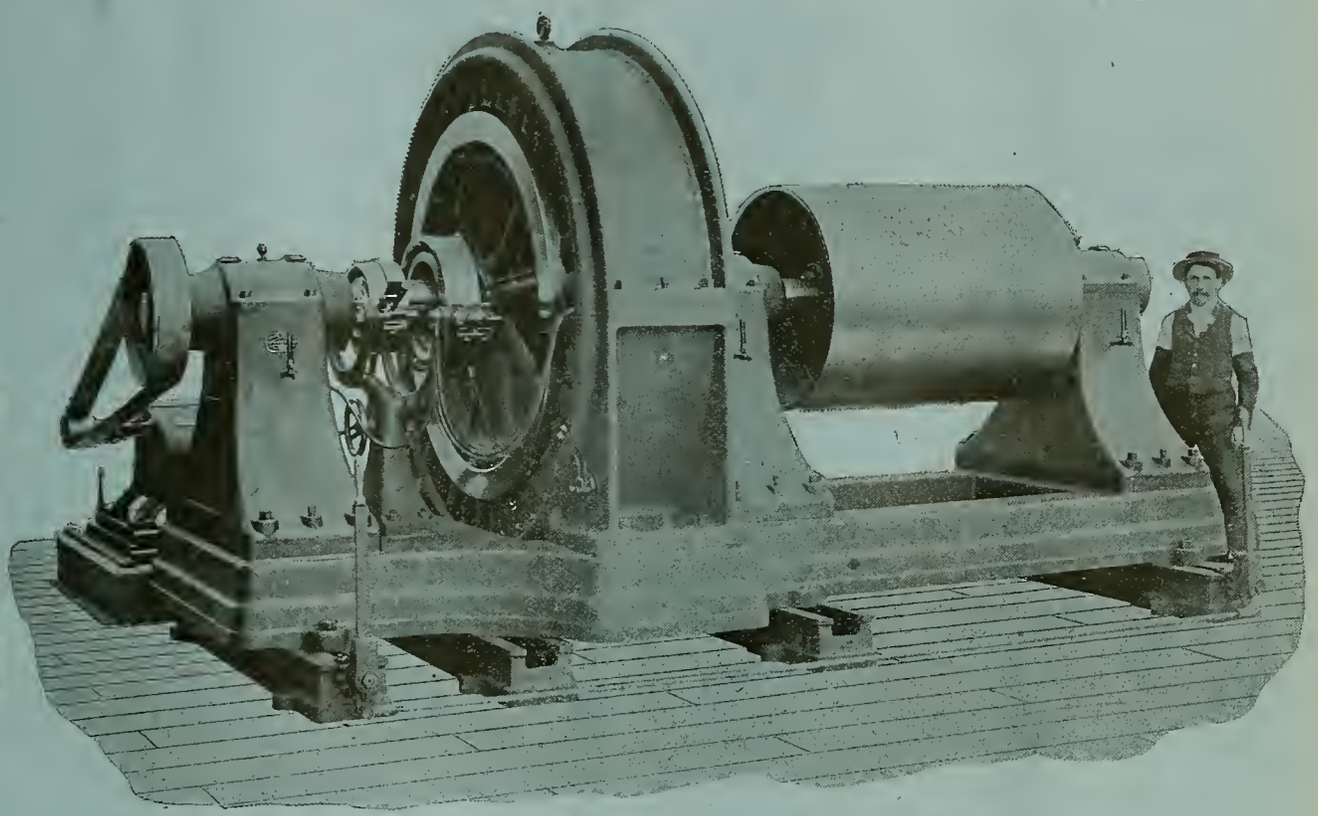

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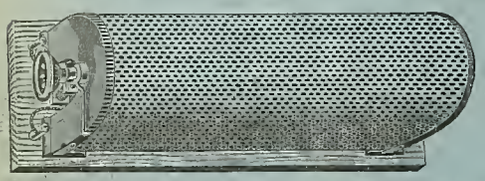

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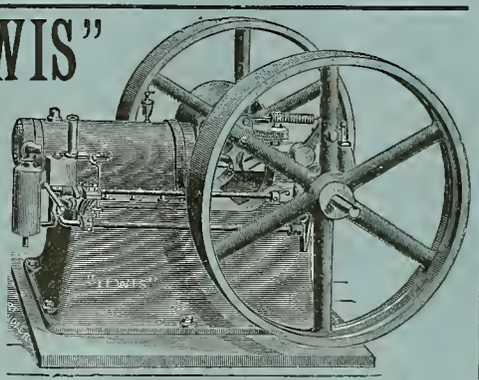

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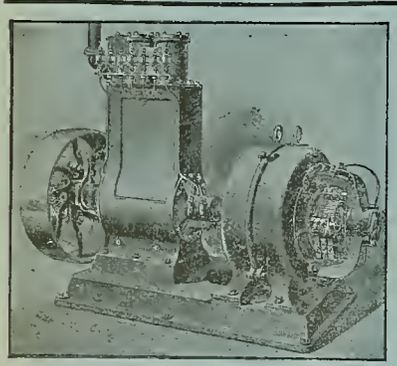

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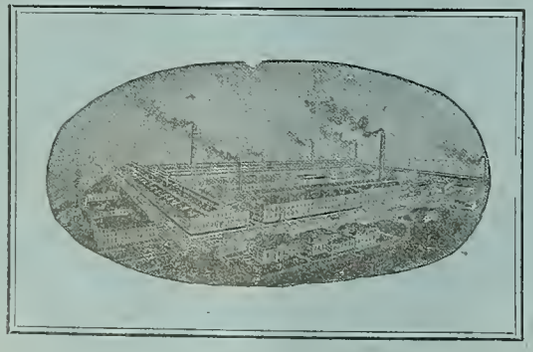

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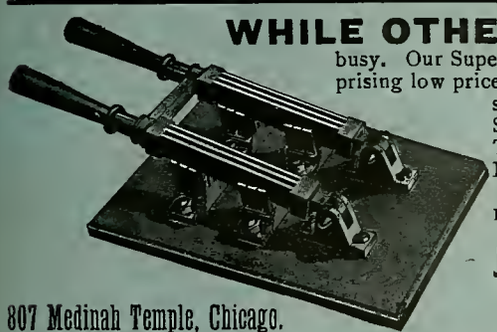

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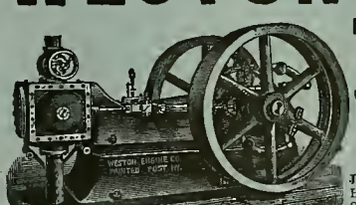

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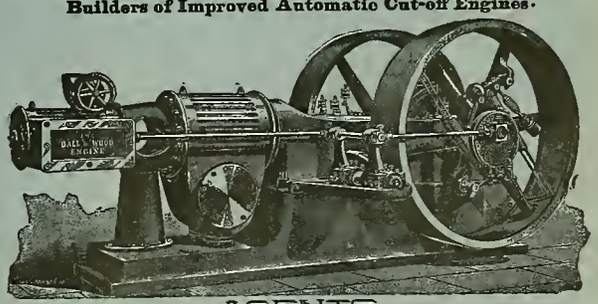

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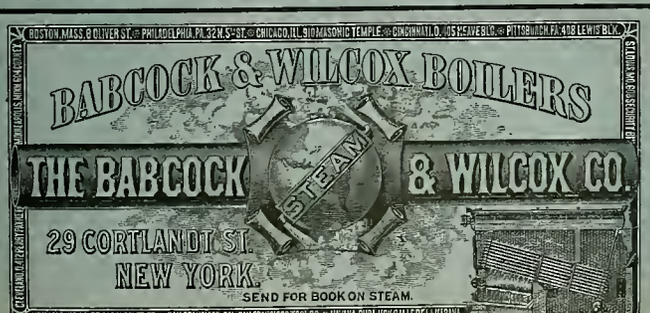


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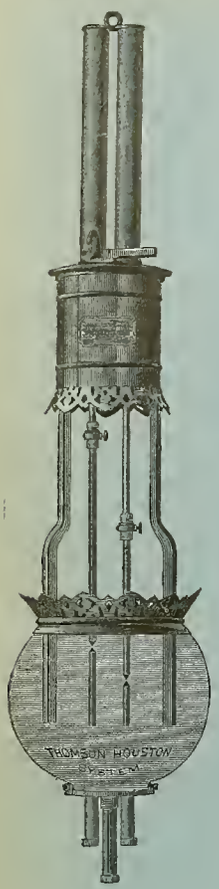


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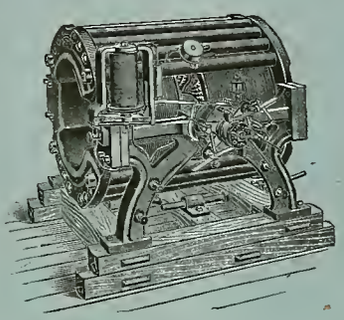

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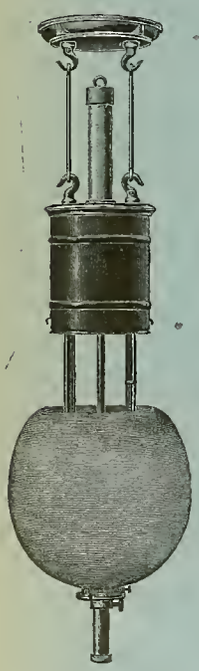

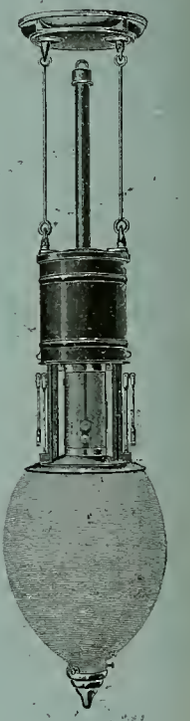

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Hill, W. S. Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons, Points & Plates.**
General Electric Co.
Partridge Carbon Co.
Reisinger, Hugo.
Western Electric Co.

**Car-Heaters, Electric.**
Consolidated Car-Heating Co.

**Clocks, Electric.**
Self-Winding Clock Co.

**Conduits**
Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Muncie Elec. Mfg. Co.
Washington Electric Co.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co
Muncie Elec. Mfg. Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
National India Rubber Co.
Okonite Co. The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cordage.**
Samson Cordage Wks.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Electric Appliance Co.
Nuttall Co., R. D.
Partrick & Carter Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
Western Electric Co.
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**Economizers.**
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**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Rushmore, S. W.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Diamond Electric Co.
Electric Appliance Co.
Hill, W. S. Electric Co.
Interior Conduit & Ins. Co.
Large & Twining.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

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Holtzer-Cabot Electric Co.

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General Electric Co.
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Illinois Engraving Co.

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Kartavert Mfg. Co.
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Butler Hard Rubber Co.
Partrick & Carter Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.

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Holtzer-Cabot Electric Co.
Partrick & Carter Co.

**Gears.**
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Nuttall Co., R. D.

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Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
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General Electric Co.
High & Co., J. Grant.
Hill, W. S. Electric Co.
Holtzer-Caoot Electric Co.
Interior Conduit & Ins. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
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Partrick & Carter Co.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
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Empire China Works.
Hart & Hegeman Mfg. Co.
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Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
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Kartavert Mfg. Co.
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National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Paragon Insulating Co.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Technic Electrical Wks.
Wallace Electric Co.

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Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Large & Twining.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
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**Lamps, Incandescent.**
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Buckeye Electric Co.
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Muncia Elec. Mfg. Co.
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Westinghouse El. & Mfg. Co

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Cushing & Morse.
Electric Appliance Co.
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Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

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Partrick & Carter Co.
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Stanley Electric Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
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Samson Cordage Wks.

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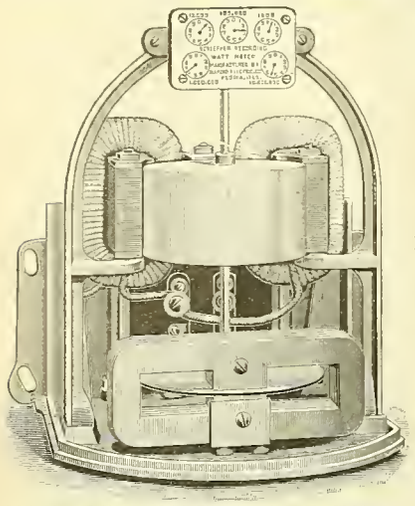
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.



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For Alternating Circuits. No Commutator. No Brushes.

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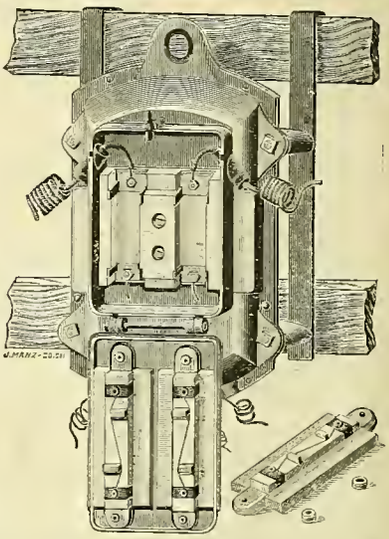

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Simplest, Safest and Best.

FOR ANY VOLTAGE. FOR ALL SYSTEMS.

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# THE STANLEY

## Two-Phase System of Alternating Apparatus,

***The first and only complete and perfected system by which light and power can be supplied from the same generator. Power transmission and distribution made practical and commercially successful.***

In construction and operation the entire system is much more simple than any other, either direct or alternating.

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They can be built for any voltage from 110 for isolated lighting to 5,000 for power transmission work.

The motors excel in simplicity of construction; in starting torque and simplicity of starting device; in efficiency in the manner in which they take current in proportion to their load, and in the uniformity of speed under the different conditions of load.

Our transformers insure satisfactory service and the greatest economy. We are prepared to fill all orders promptly, and carry a full stock of transformers in Chicago.

"No practical station man who has seen a Stanley alternator in operation will ever be satisfied with any other."

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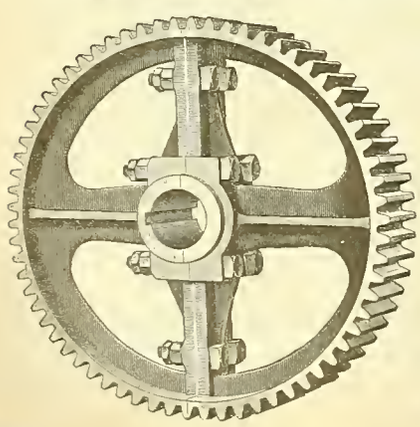
J. R. McGINLEY, Vice-President.
F. S. MARTIN, Superintendent of Works.



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## Electric Railway Supplies.

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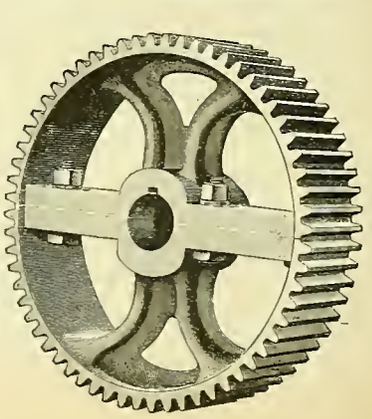
THIS IS THE IMPROVED NUTTALL TROLLEY.

TRY IT ONCE, AND YOU WILL WANT NO OTHER.



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CHAS. J. MAYER, 600 Betz Building, Philadelphia, Pa., Middle States Sales Department.
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# THE A.-W. ARC LAMP.

That burns on any current.

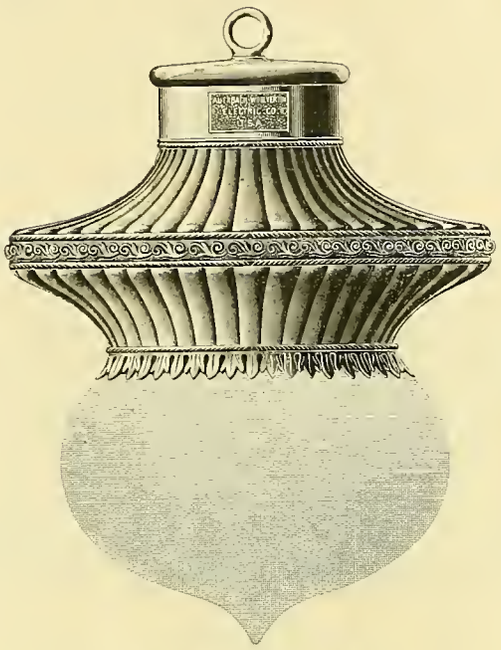
That measures 18 inches from top to bottom (including globe).

That has a life of 25 hours in the open air.

That throws light where you want it—on the ground.

That feeds neither by rack, clutch, clockwork, nor chain.

That casts no shadow whatever.



That gives the maximum light distribution.

That gives an absolutely steady light.

That keeps the arc stationary.

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**SIMPLICITY AND DURABILITY OF CONSTRUCTION.**

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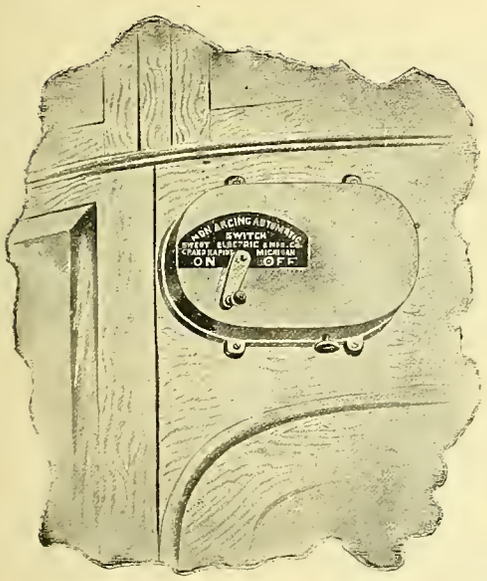


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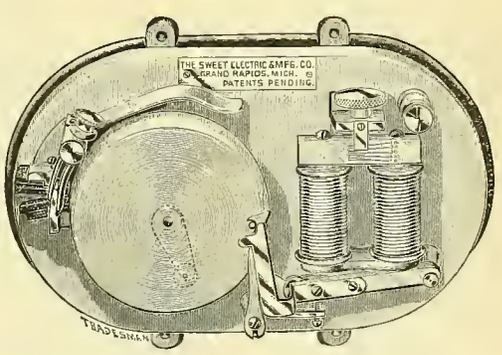


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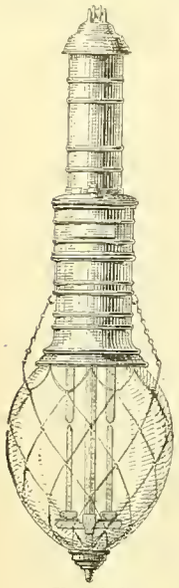

No. 2607
"Twin" Lamp.

# The New "Bergmann" Arc Lamps

**For Constant Potential Circuits.**

## BETTER than all others BECAUSE

THEY HAVE

**No Adjusting Springs and No Escapements**

AND CONSEQUENTLY CAN

**Not Get Out of Adjustment or Flicker or Stick.**

**Send for Descriptive Circular of Direct and Alternating Current Lamps, Blade Switches, Imported Carbons, Etc. Prices greatly reduced on everything.**

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No. 2425
A. C. Lamp.

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**NEW YORK.**

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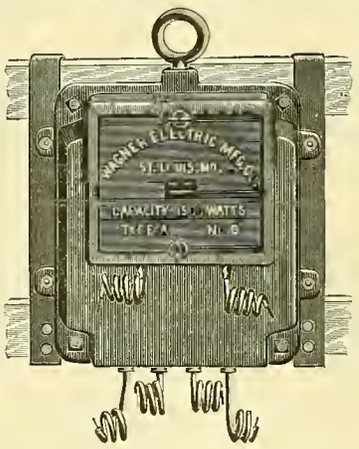
Highest Efficiency Ever Obtained.




Standard Sizes, 5 Lights to 2,000 Lights.

## TRANSFORMERS

To order for any purpose, voltage or capacity.

## ALTERNATING CURRENT MOTORS.

## HIGH POTENTIAL SWITCHES,

## Complete Switch Boards

For Central Stations and Isolated Plants.

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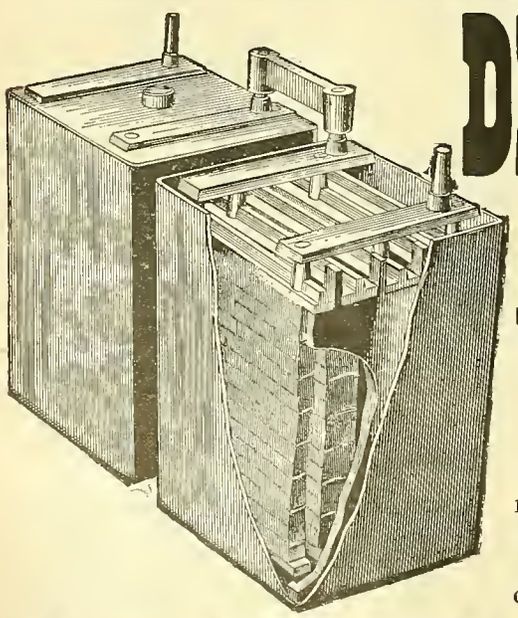

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By all who have used

## STANDARD PLANTÉ BATTERIES.

Will not **Sulphate** nor **Disintegrate,** and cannot **Buckle.**

**HIGHEST EFFICIENCY,**

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**LEAST INTERNAL RESISTANCE.**

**Cells from 10 to 10,000 Ampere-Hour Capacity.**

## CENTRAL STATION INSTALLATIONS.

Batteries for **Electric Launches,** for **Dental, Surgical** and **Medical Work,** and for all purposes for which electricity is required.

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Complete Lighting and Power Plants installed as reasonably as consistent with first-class material and workmanship.

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## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

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# "The Electra"

# CARBONS.

A highly EFFICIENT and ECONOMICAL Arc Light Service depends on the quality of the Carbons.

**THE BEST QUALITY IS THE CHEAPEST.**

ELECTRA ·TRADE MARK·

Highest Award at the World's Columbian Exposition, Chicago, 1893.

## High Grade Nuernberg Carbons

For direct and alternatinng current Arc Lamps, are the most economical and efficient manufactured. They produce a very brilliant and absolutely steady light.

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Highest Award at the World's Columbian Exposition, Chicago, 1893.

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**HUGO REISINGER,** No. 38 BEAVER STREET, NEW YORK,

Sole Importer for the United States, Canada, Etc.

# We Want Western Business.

## LA ROCHE ALTERNATORS.

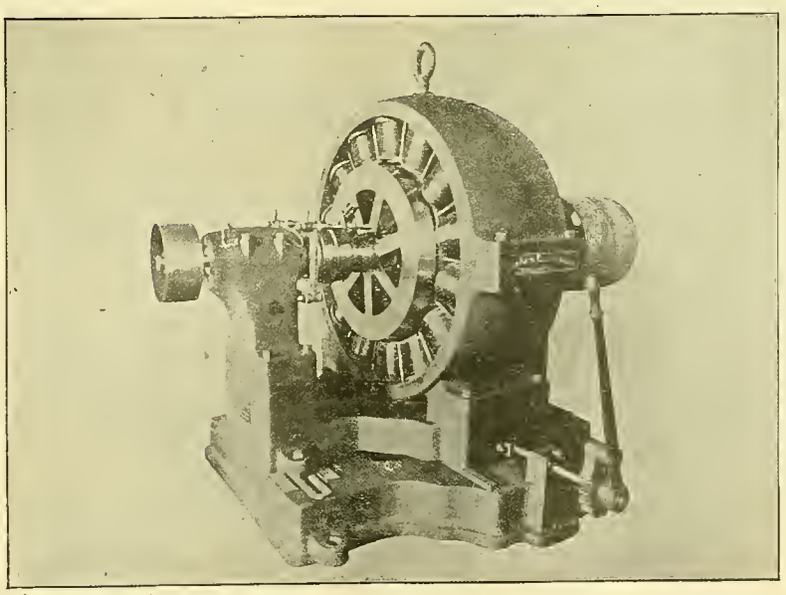
Manufactured in Sizes from

**25 to 5,000 Lights,**

**SINGLE**
OR
**MULTIPHASE.**

Direct Connected Dynamos.

Direct Current Generators.



**1,000 Light Alternator.**

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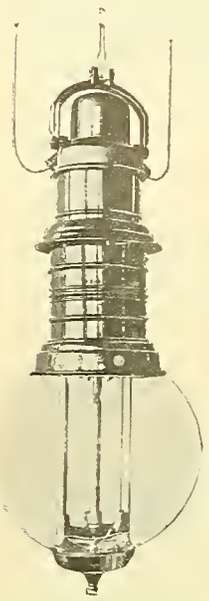
# THE HELIOS

## New Alternating Arc Lamp

### For Street Lighting



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Street Lamp, either 12 or 14 hour, to be used in connection with Special 33 Volt Transformer.

New Alternating Lamp 900 c. p, 7 amperes at 28 volts or 4½ amperes at 50 volts, 2¼ amperes at 100 volts. It consumes the energy of 3½ 16 c. p. incandescent lamps. A small alternating lamp is only possible with a reflector plate.

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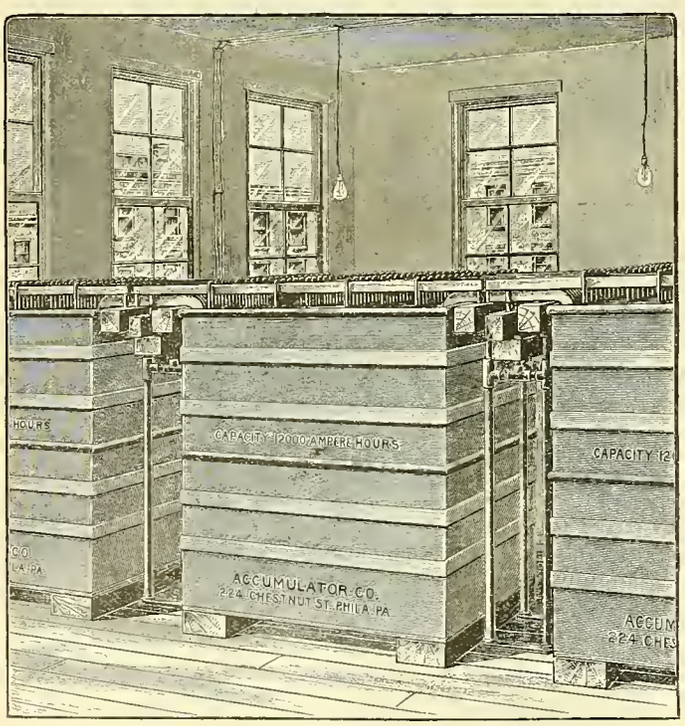


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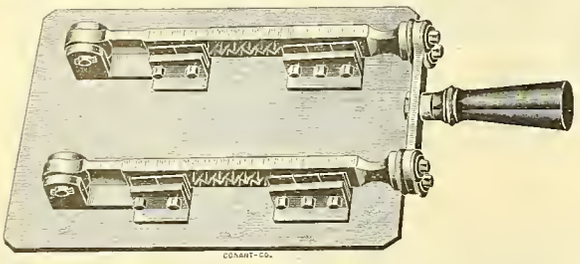

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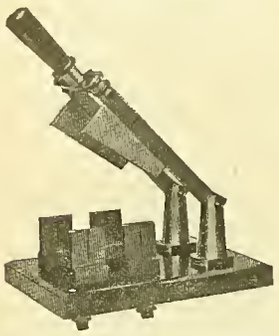

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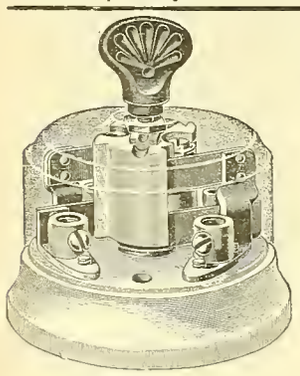

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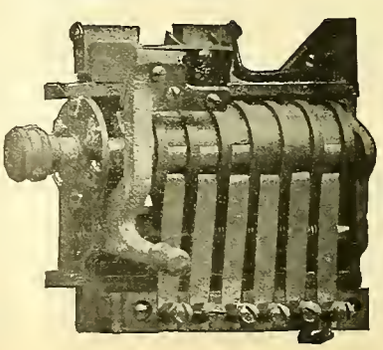

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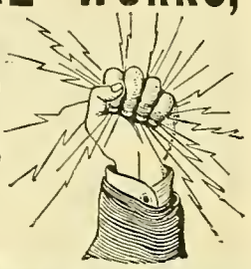

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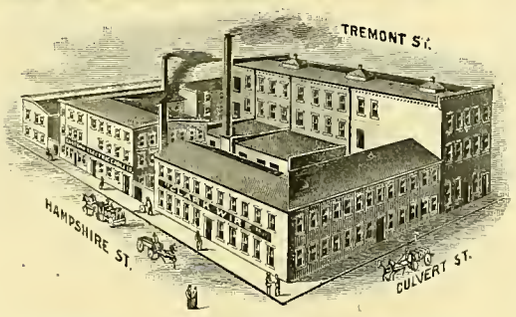


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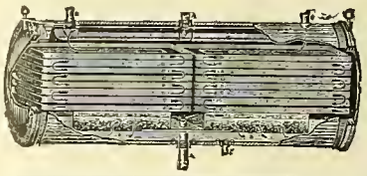

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Notice is also given that the undersigned will apply to the District Court in and for the County of Ramsey, Minnesota, at a special term of said court, to be held in the City of St. Paul, Minnesota, on the 17th day of November, A. D. 1894, at 10 o'clock in the forenoon on said day or as soon thereafter as counsel can be heard, for an order confirming said sale.

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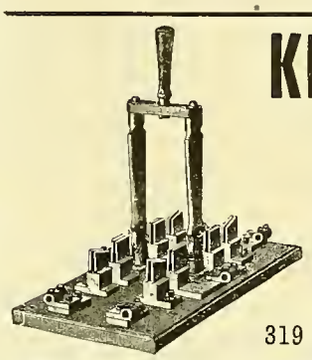

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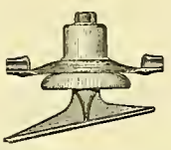

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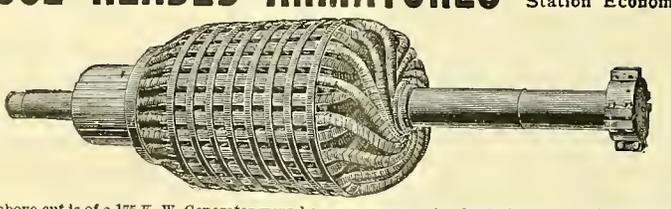

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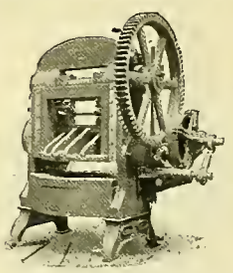

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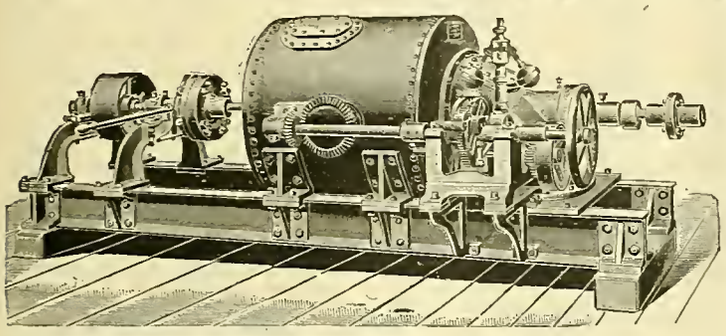

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The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high speed and great efficiency and large capacity** for its **diameter**, being **double** the **power** of most wheels of the same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

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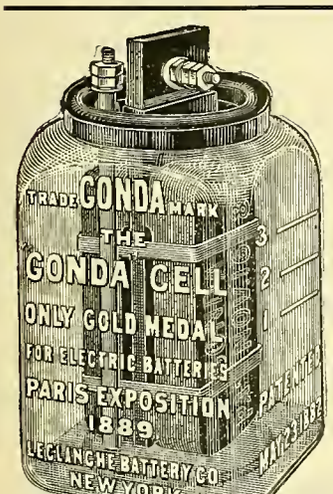


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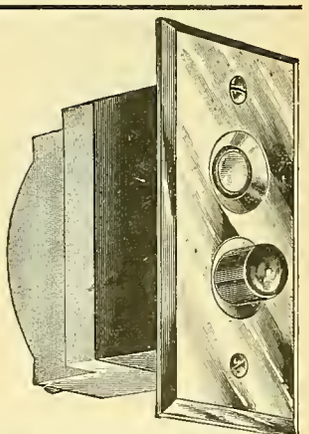

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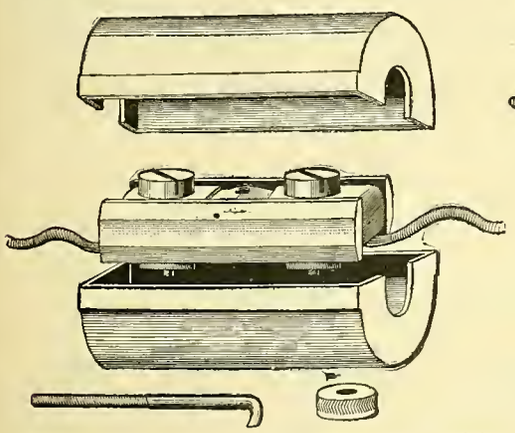

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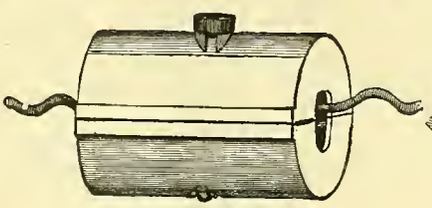

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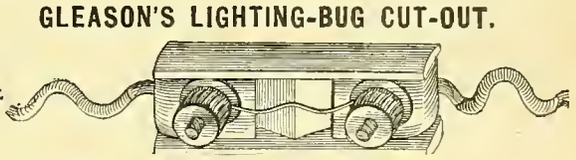

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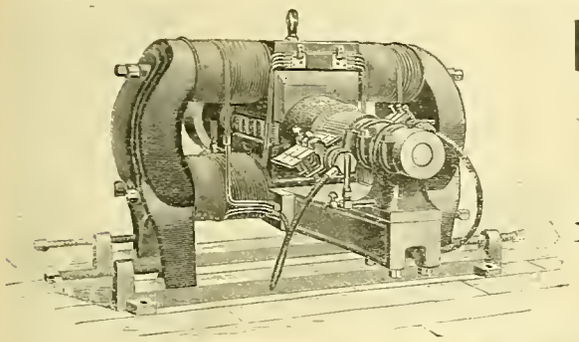

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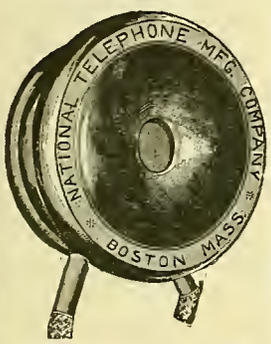


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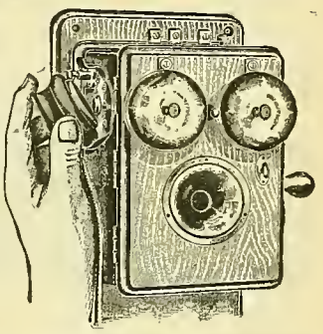

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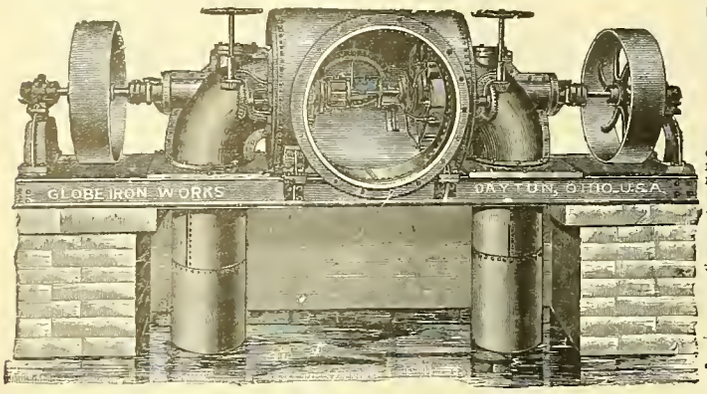


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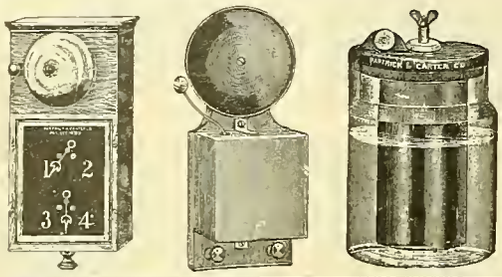

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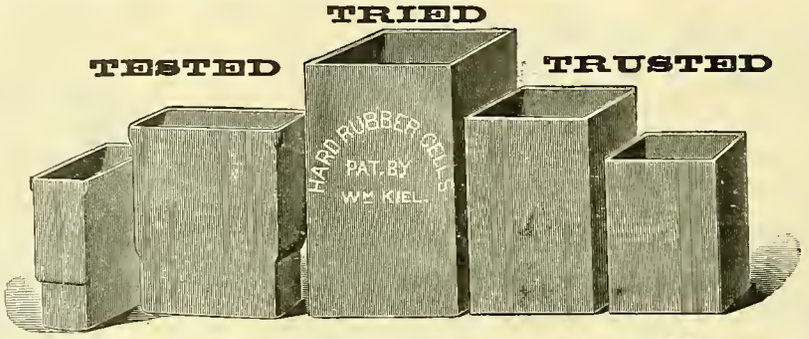


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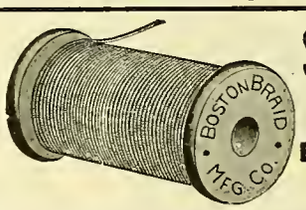


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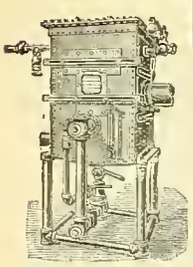

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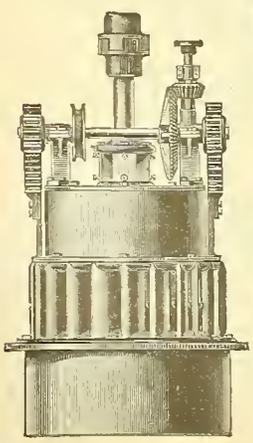

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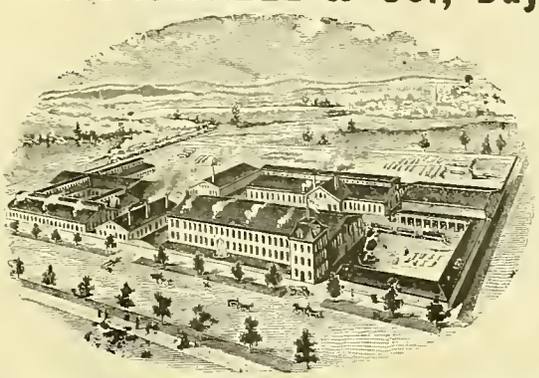

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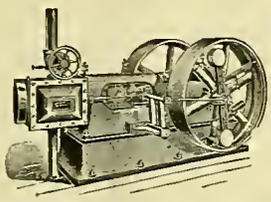

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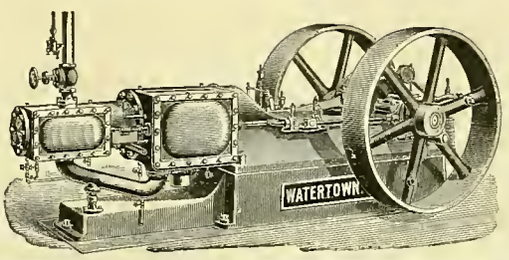


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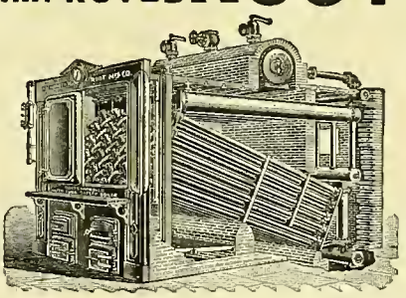

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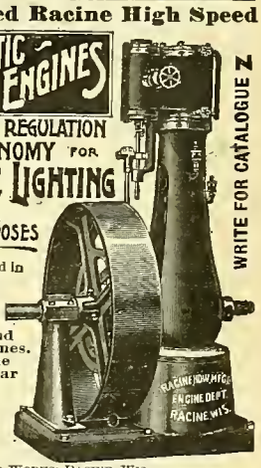


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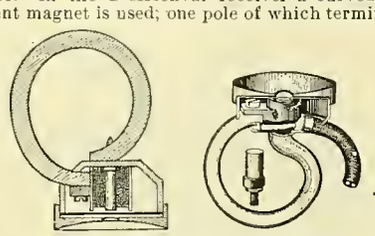
ductor. In the D'Arsonval receiver a curved permanent magnet is used; one pole of which terminates



FIGS. 27 AND 28. D'ARSONVAL RECEIVER.

in a soft iron polepiece that serves as the core of the coil, and the other in an iron box, or cylinder, that

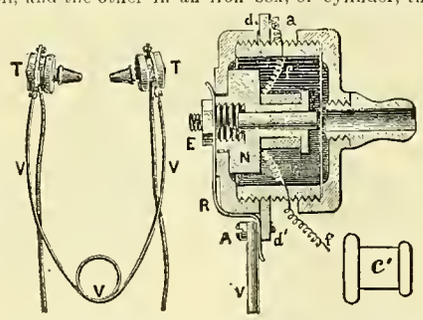



FIG. 29. MERCADIER'S BI-TELEPHONE. *T T* RECEIVERS, *V* SPRING, *N* MAGNET, *E* NUT, *R* STEEL STRIP, *A* SCREW CLAMPING *R* TO *V*, *d d'* METAL COLLAR CLAMPING *V* TO RECEIVER CASE, *f f* TERMINALS OF COIL *a* CONNECTING SCREW, *c'* SOFT RUBBER NIPPLE FOR EARPIECE.

completely encloses the coil. The two poles are magnetically insulated from each other by the wooden case, to the upper part of which the diaphragm is

48 TELEPHONE HAND BOOK.

appeared on the scene with an application for a patent on a microphonic transmitter, and according to the rules of the Patent Office no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbaugh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbaugh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad

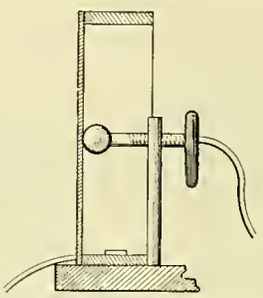


FIG. 44. BERLINER'S FIRST TRANSMITTER.

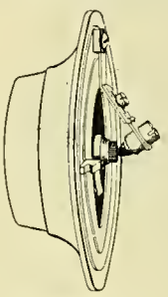


FIG. 45. BERLINER CARBON TRANSMITTER.

principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

78. Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by caus-

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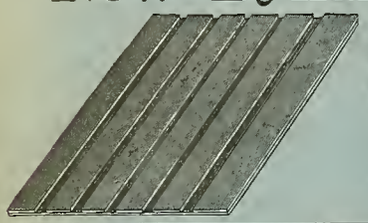

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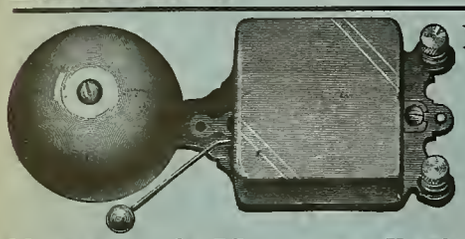

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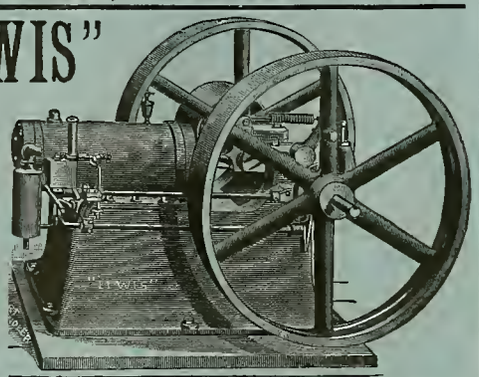

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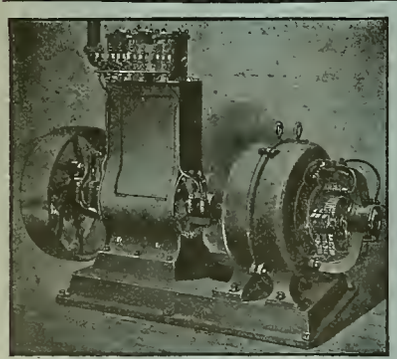

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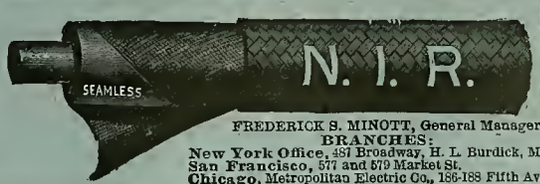


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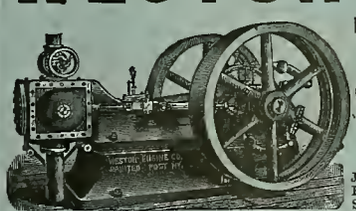

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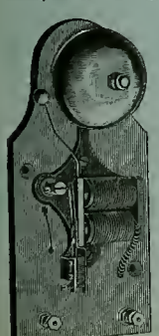

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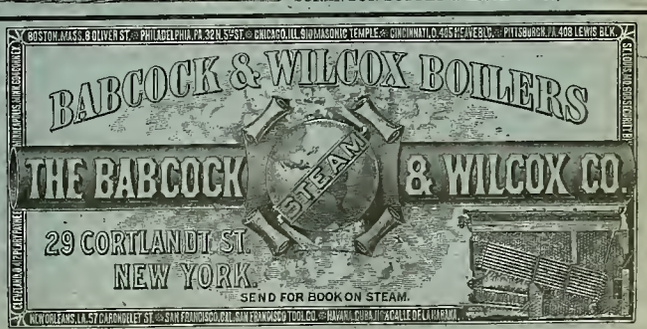


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Accumulator Co.
Boswell & Co., D. E.,
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
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Electric Appliance Co.
Huebel & Manger.
Ostrander & Co., W. R.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
Auerbach-Woolverton El. Co.
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Hellos Electric Co., The.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Arc Light Cord.**
Samson Cordage Wks.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Hunnell & Co., J. H.
Butler Hard Rubber Co.
Electric Appliance Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Hayden-Booker Mfg. Co.
Law Battery Co.
Leclanche Battery Co., The.
Miamisburg Electric Co.
Partrick & Carter Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Electric Appliance Co.
Huebel & Manger.
Ostrander & Co., W. R.
Proctor-Raymond Elec. Co.
Western Electric Co.

**Belting.**
Shultz Belting Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co., The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Racine Hardware Co.
Weston Engine Co.

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Electrician Publishing Co.

**Brushes.**
Partridge Carbon Co.

**Burglar Alarms.**
Electric Appliance Co.
Partrick & Carter Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

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**Cables, Electric.** (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Cushing & Morse.
Eastern Electric Cable Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

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General Electric Co.
Partridge Carbon Co.
Reisinger, Hugo.
Western Electric Co.

**Car-Heaters, Electric.**
Consolidated Car-Heating Co.

**Clocks, Electric.**
Self-Winding Clock Co.

**Conduits**
Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Muncie Elec. Mfg. Co.
Washington Electric Co.

**Contractors and Electric Light Plants.**
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Amstutz, N. S.
Armstrong, Chas. G.
Arnold, E. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. B.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
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Fontaine Crossing & El. Co.
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General Electric Co.
Goltz & Sinclair.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co
Muncie Elec. Mfg. Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Metropolitan Elec. Co.
National India Rubber Co.
Okonite Co. The.
Phillips Insulated Wire Co.
Roehling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cordage.**
Samson Cordage Wks.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Electric Appliance Co.
Nuttall Co., R. D.
Partrick & Carter Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Interior Conduit & Ins. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Elec. Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Gregory, Chas. E. Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Muncie Elec. Mfg. Co.
Palmer Bros.
Roth & Eck.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
Western Electric Co.
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Consolidated Car Heating Co.

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General Electric Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
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Allen-Bussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. B.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Rushmore, S. W.

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Bernard Co., The E. G.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
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Electric Appliance Co.
Interior Conduit & Ins. Co.
Large & Twining.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

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**Electric Slate.**
Independent Electric Co.

**Electroliers, etc.**
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Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Gas.**
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**Engines, Steam.**
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Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Engravers.**
Illinois Engraving Co.

**Fan Outfits.**
Holgiano Mfg. Co.
Interior Conduit & Ins. Co.
Muncie Elec. Mfg Co.

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Butler Hard Rubber Co.
Kartavert Mfg. Co.
Standard Paint Co.
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General Electric Co.
Independent Electric Co.

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Holtzer-Cabot Electric Co.
Partrick & Carter Co.

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Grant, Geo. B.
Nuttall Co., R. D.

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Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
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High & Co., J. Grant.
Holtzer-Cabot Electric Co.
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Metropolitan Elec. Co.
Palmer Bros.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
Techoic Electrical Wks.
Washington Electric Co.
Wallace Electric Co.
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**Globes and Electrical Glassware.**
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Phœnix Glass Co.

**Graphite Specialties.**
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Splitdorf, C. F.

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Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
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Standard Paint Co.
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**Insulated Wires and Cables—Magnet Wire.**
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Bunnell & Co., J. H.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Large & Twining.
Metropolitan Elec. Co.
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Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

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Electric Appliance Co.
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General Electric Co.
Mather Electric Co.
New York & Ohio Co.
Partrick & Carter Co.
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Westinghouse Elec. & Mfg. Co.

**Lightning Arresters.**
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Electric Appliance Co.
General Electric Co.
Hill, W. S. Electric Co.

**Magnet Wire.**
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Bliss Co., E. W.
Hine & Robertson Co.

**Mica.**
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Munsell & Co., Eugene.

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Standard Paint Co.

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Worthington, Henry R.

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Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

**Street Cars.**
Brill, J. G. Co.

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American Electrical Works.
Cushing & Morse.
Electric Appliance Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

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Partrick & Carter Co.
Western Electric Co.

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National Telep. Mfg. Co.
Palmer Bros.
Partrick & Carter Co.
Western Electric Co.
Western Tel. Const. Co.

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Bradley & Co.

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General Electric Co.
Hornberger Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Trolley Cord.**
Samson Cordage Wks.

**Trucks, Electric Car.**
General Electric Co.
Westinghouse El. & Mfg. Co.

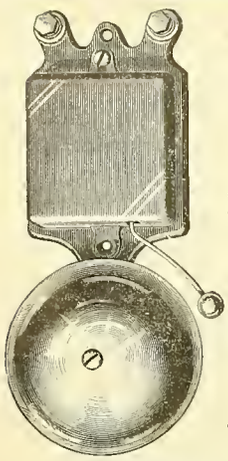
**Turbine Wheels.**
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

**Universities.**
Cor. School of Industrial Sciences.
Scientific Machinist Co.

**Varnishes.**
Standard Paint Co.

**Water Wheels.**
Leffel & Co., Jas.
Smith, S. Morgan.

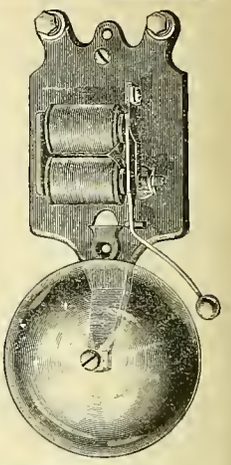
**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Electric Appliance Co.
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.



# "ECLIPSE"

## IRON BOX BELL

It Eclipses all others when Price and Quality are considered.
. . Prove it with a Sample order . .



## PROCTOR-RAYMOND ELECTRIC CO.

ROCHESTER, N. Y.

New York
THE LEADING SUPPLY HOUSES

Chicago
THE LEADING SUPPLY HOUSES

Boston
ANCHOR ELECTRIC CO.
PETTINGELL-ANDREWS CO.

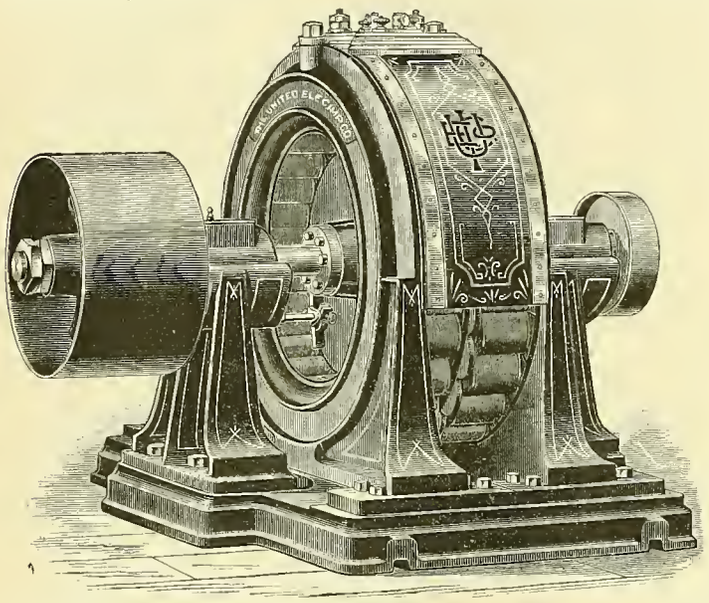
Cincinnati
THE JONES BROS. ELEC. CO.

St. Louis
COMMERCIAL ELECTRICAL SUPPLY CO.

Pittsburg
ROBBINS ELECTRIC CO.

# REMOVAL NOTICE!

The United Electric Improvement Co. have removed their office and works to new factory building, Allegheny Ave. and 19th St., Philadelphia, Pa. Convenient to Germantown Junction on Penna R. R, and Tioga Station on the Phila. & Reading R. R. Can also he reached by 13th St. Trolley Line.



Our increased facilities will enable us to carry in stock for prompt delivery Alternating Current Generators, Direct Current Apparatus for lighting and transmission of power, and Improved Long Distance Series Incandescent Apparatus; also a full line of Series Incandescent Lamps of improved manufacture.

Correspondence Solicited

## The United Electric Improvement Co.,

Allegheny Ave. and 19th St., Philadelphia.

# ARC LAMPS FOR INCANDESCENT

Circuits, Both Alternating and Direct.

**Standard "Ward" Lamps, $10 Each.**

TWO IN SERIES ON 110 VOLTS.

Globe and Resistance, $2.00 extra per lamp.

## A Complete Line

Of ENTIRELY NEW Arc Lamps.

SIMPLEST. STRONGEST. SUREST FEED.

Easiest and Cheapest to Maintain.

*SPECIAL LAMPS OF ALL KINDS.*

WRITE US FOR CIRCULARS.

We carry a stock of FIDELITY carbons and IMPORTED CORED carbons, which we are selling at reduced prices.

USERS OF ARC LAMPS SHOULD WRITE US FOR PRICES.

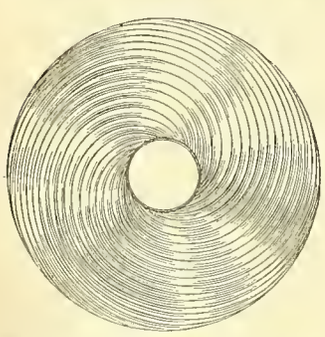
## Electric Construction & Supply Co.,

18 Cortlandt Street, New York.
(Established 1881.)

Wallace Electric Co., Agents, 307 Dearborn Street, Chicago, Ill.

# E. P. GLEASON MFG. CO.,

181-189 Mercer St., NEW YORK.
183 Dearborn St., CHICAGO.



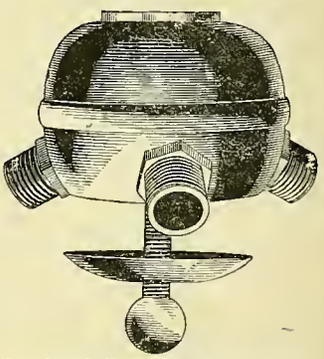
Flat Spiral Corrugated Reflector.

*Big reduction in prices all through our line.*

ES04½C

Pat. pending. Metal Half Reflector shade, Green Outside, White Enamel Inside No. extra holder necessary. Made to fit any socket.

*Send for quotations and compare with the lowest.*



Sectional Ball Cluster. E471. 2, 3, or 4 lights, has a detachable lower section that forms a finishing piece.

# AFFIRMATION!

ANOTHER

# IMPORTANT DECISION!

A decision was handed down on November 15th, in the United States Court of Appeals for the Second Circuit, in the case of the Accumulator Company against the Edison Electric Illuminating Company and the Electric Storage Battery Company by Judges Wallace, Shipman and Townsend, affirming the decision of Judge Lacombe enjoining the Edison Electric Illuminating Company of New York from using the chloride battery, on the ground that it is an infringement of the Swan reissue patent.

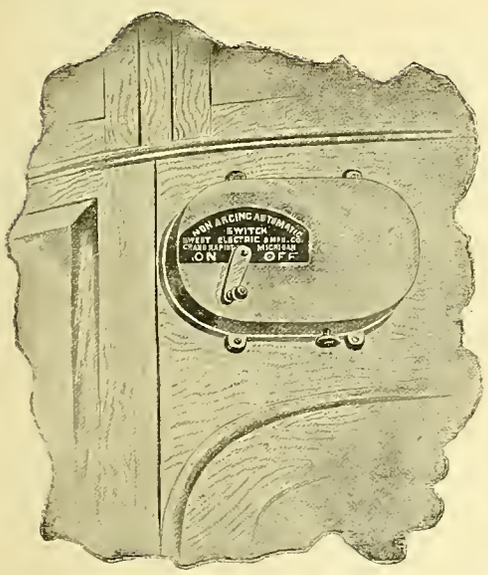
---

# The Accumulator Co.,

224 Chestnut Street, - - - - Philadelphia, Pennsylvania.

---

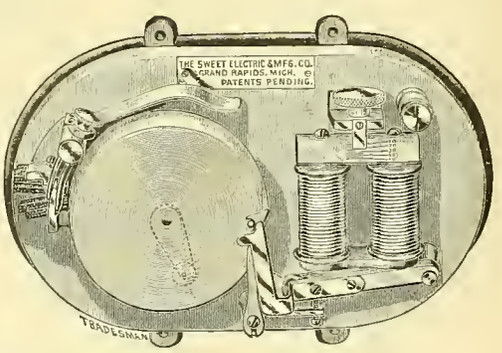
# STREET RAILWAY MANAGERS.




We now have the device you have long been looking for: Automatic Magnetic Circuit Breaker for your motor cars. Our device only occupies a space of 11x8x3 inches; sensitive, $\frac{1}{4}$ ampere over its set capacity will operate it, and still the jolting and jar of the car has no effect on it.

## Expensive?

**No, cheaper than a fuse box. Write us.**

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# SWEET ELECTRIC & MFG. CO.,

**GRAND RAPIDS, MICHIGAN.**

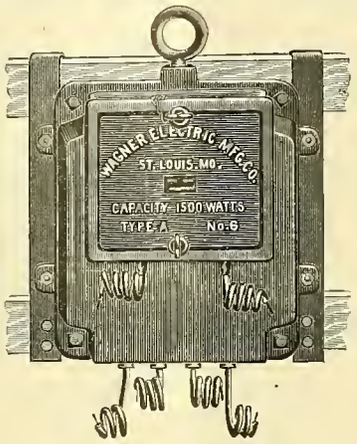
# ALTERNATING CURRENT TRANSFORMERS

Highest Efficiency Ever Obtained.

## TRANSFORMERS

To order for any purpose, voltage or capacity.

**ALTERNATING CURRENT MOTORS.**




Standard Sizes, 5 Lights to 2,000 Lights.

**HIGH POTENTIAL SWITCHES,**

Complete Switch Boards

For Central Stations and Isolated Plants.

# WAGNER ELECTRIC MFG. CO., ST. LOUIS, MO.

# New York Insulated Wire Co.,

**Sole Manufacturers,**

Grimshaw White Core and Raven Core Wires, Grimshaw Underground Lead Covered Cables,
Competition Line Wires, Grimshaw Tapes and Splicing Compound,
Vulca Bushings, all sizes, Vulca Electrical Wire Ducts for Interior Construction.

**New York Insulated Wire Company,**

MAIN OFFICE: 13-17 Cortlandt Street, New York.
BRANCHES: CHICAGO: 78-82 Franklin Street. BOSTON: 134 Congress Street. SAN FRANCISCO: 102 Sacramento Street.

The most Powerful Receiver Known—Patented May 29, 1894.

"NATIONAL" COMPOUND RECEIVER.

## The "NATIONAL."

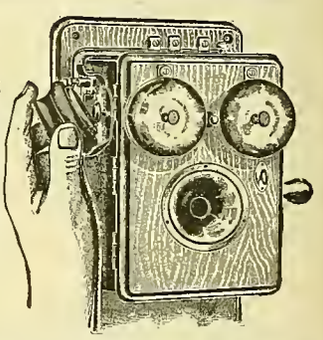
We make simply a business proposition. Buy two sets of our instruments and make your own tests. If satisfactory the way is open for more business, either in telephones or switchboards for exchanges.

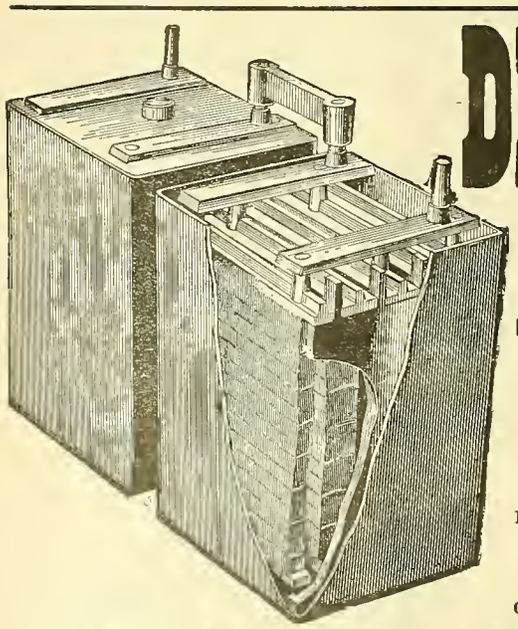
Our head telephones are largely used by Bell telephone operators.
The "NATIONAL" is in use at the U. S. Military Academy, West Point, N. Y.

## NATIONAL TELEPHONE MFG. CO.,

**620 (W) Atlantic Avenue, Boston, Mass.**

"NATIONAL." Method of Placing Receiver in Holder.





# DECISION IN OUR FAVOR

By all who have used

## STANDARD PLANTÉ BATTERIES.

Will not **Sulphate** nor **Disintegrate,** and cannot **Buckle.**

**HIGHEST EFFICIENCY,**
**LARGEST DELIVERY,**
**LEAST INTERNAL RESISTANCE.**

**Cells from 10 to 10,000 Ampere-Hour Capacity.**

## CENTRAL STATION INSTALLATIONS.

Batteries for **Electric Launches,** for **Dental, Surgical** and **Medical Work,** and for all purposes for which electricity is required.

**BATTERIES FOR TRACTION USE.**

Complete Lighting and Power Plants installed as reasonably as consistent with first-class material and workmanship.

## ELECTRIC-POWER STORAGE COMPANY,

**Room 1210, Havemeyer Building, 26 Cortlandt Street, NEW YORK.**

# THE C & C ELECTRIC COMPANY

MANUFACTURERS OF

## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

**General Office:**
**143 Liberty Street, NEW YORK.**

**Works: GARWOOD, N. J.**
**on CENTRAL R. R. of N. J.**

**BRANCH OFFICES:** CHICAGO, 1020 and 1021 Monadnock Building. BOSTON, 63 Oliver St. CLEVELAND, Cuyahoga Building. PHILADELHIA, 633 Arch St.

## A BRAND NEW ARC LAMP.

# THE A.-W. ARC LAMP.

That burns on any current.

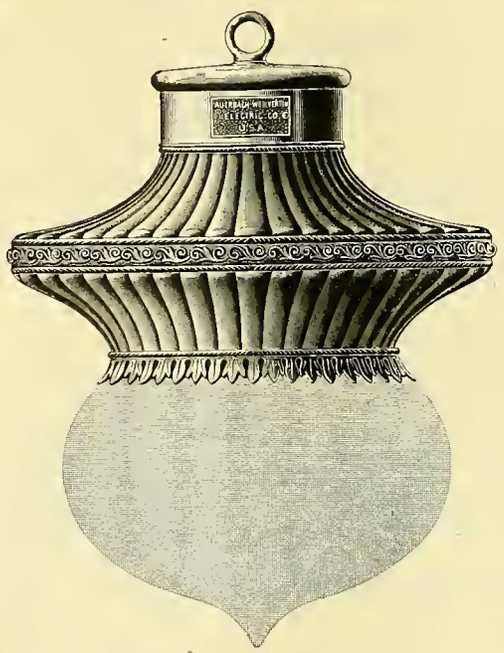
That measures 18 inches from top to bottom (including globe).

That has a life of 25 hours in the open air.

That throws light where you want it—on the ground.

That feeds neither by rack, clutch, clockwork, nor chain.

That casts no shadow whatever.



That gives the maximum light distribution.

That gives an absolutely steady light.

That keeps the arc stationary.

That feeds independent of the magnet.

**SIMPLICITY AND DURABILITY OF CONSTRUCTION.**

**THE MOST ORNAMENTAL LAMP IN THE MARKET.**

# AUERBACH-WOOLVERTON ELECTRIC CO.,

**Cable Building, Houston St. and Broadway, NEW YORK CITY.**

# STREET LIGHTING FROM ALTERNATING CURRENT DYNAMOS.

**New Prices given on** **Lamps, Street Fixtures, Bank Boards, Series Sockets, Poles, Meters**

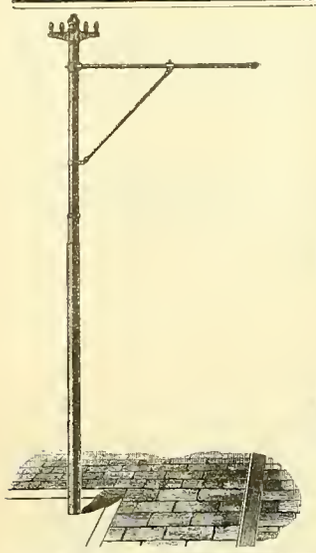
**And all accessories for the use of SERIES LAMPS on ALTERNATING CURRENT DYNAMOS.**

*This system permits a PROFITABLE and SATISFACTORY method of street illumination and should be investigated by every plant using alternating current apparatus. WRITE FOR FURTHER PARTICULARS AND PRICES.*

## OUR SERIES LAMPS

*Will show you a COMPARATIVE SAVING equal to their FIRST COST in POWER CONSUMED.*

## BERNSTEIN ELECTRIC COMPANY, 620 Atlantic Ave., Boston, Mass.



1821. 1888.

# MORRIS, TASKER & CO.,

INCORPORATED.

Offices, 222-224 S. Third St., Philadelphia, Pa.

PASCAL IRON WORKS, PHILADELPHIA.

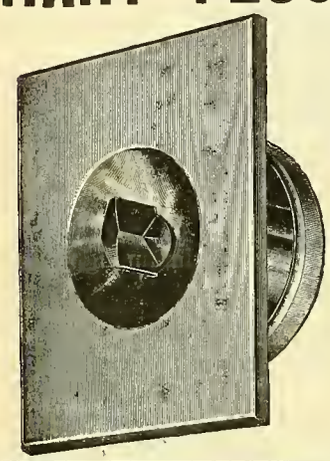
DELAWARE IRON WORKS, NEW CASTLE, DEL.

Manufacturers of

## Boiler Tubes, Wrought Iron Pipes and Fittings.

ELECTRIC LIGHT and RAILWAY PIPE POLES A SPECIALTY.

## HART FLUSH SWITCHES.



5 and 10 Ampere Single Pole.
10 Ampere Double Pole.
10 Ampere Three-way.

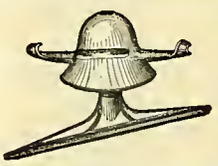
The Only Snap Switch that has

PROVEN A SUCCESS.

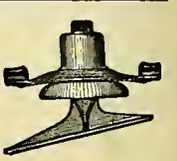
For Sale by All Supply Houses.

The Hart & Hegeman MANUFACTURING CO.,

HARTFORD, CONN.



## MOULDED MICA



## TROLLEY LINE INSULATORS.

*Hangers, Pull-Overs, Bracket Arm Insulators, Guard Wire, Feed Wire, Giant Strain and Section Insulators, Frogs, Crossings, Rail Bonds, Etc., Etc.*

**VULCABESTON** heat-proof insulation for Magnet Spools, Bushings, Controller parts, Etc.

**ASBESTOS** for Fire-Proofing and Electrical Purposes.

H. W. JOHNS MFG. COMPANY,
*240 and 242 Randolph Street, - CHICAGO, ILL.*
NEW YORK. PHILADELPHIA. BOSTON.

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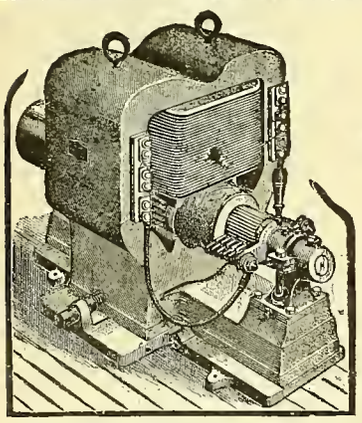

Manufacturers of the

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## MOTORS and DYNAMOS.

1 to 50 Horse Power Motors.
18 to 700 Lights' Capacity Dynamos.

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Agents Wanted. Muncie, Ind.

## Electricians---Are You Progressive?

...BY...
C. K. MAC FADDEN
...AND...
WM. D. RAY.

If so, you will be interested in any book that will give you the latest information on that subject....

OUR NEW BOOK,

"The Practical Application of Dynamo Electric Machinery"

...IS A STRICTLY 1894 BOOK...

and gives many new points for *Dynamo Tenders, Motor Men, Linemen,* and all other branches. Each subject is thoroughly treated, and in such a manner, that it can be readily understood. The Book is profusely illustrated with *Original Cuts,* showing latest improvements, etc. *168 Pages,* good paper, flexible binding, size suitable for pocket.

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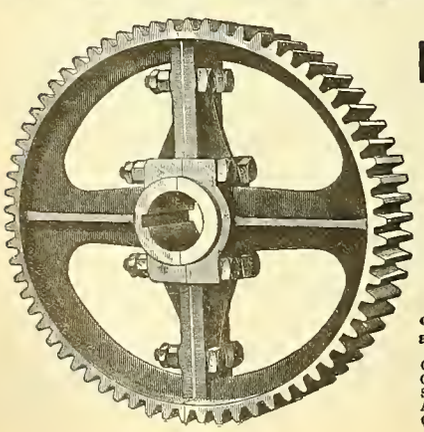
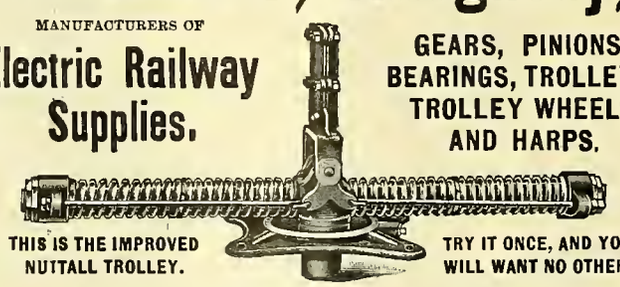
## R. D. NUTTALL COMPANY, Allegheny, Pa.

F. A. ESLER, President and Treasurer.
J. R. McGINLEY, Vice-President.
F. S. MARTIN, Superintendent of Works.



MANUFACTURERS OF

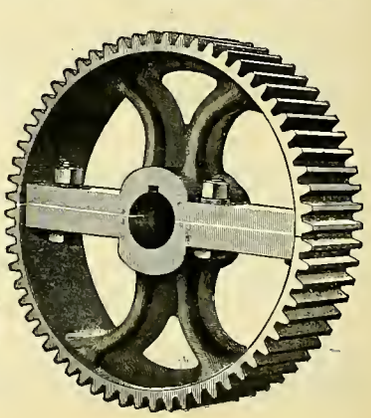
Electric Railway Supplies.



GEARS, PINIONS, BEARINGS, TROLLEYS, TROLLEY WHEELS AND HARPS.

THIS IS THE IMPROVED NUTTALL TROLLEY.

TRY IT ONCE, AND YOU WILL WANT NO OTHER.



**The largest and most prosperous street railway companies in the country are using our supplies, and they prefer them to all others on account of greater strength and durability. Correspondence solicited.**

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CHAS. N. WOOD, 180 Summer St., Boston, Mass., New England States Sales Department.
STANDARD R'Y SUPPLY CO., Monadnock Block, Chicago, Ill., N. W. States Sales Department.
A. S. PARTRIDGE, Bank of Commerce Building, St. Louis, Mo., S. W. States Sales Department.
CHAS. A. CAVAGNA, Neave Building, Cincinnati, Ohio, Central States Sales Department.

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## New Alternating Arc Lamp

### For Street Lighting

No. 10.
Street Lamp, either 12 or 14 hour, to be used in connection with Special 33 Volt Transformer.

New Alternating Lamp 900 c. p, 7 amperes at 28 volts or 4½ amperes at 50 volts, 2¼ amperes at 100 volts. It consumes the energy of 3½ 16 c. p. incandescent lamps. A small alternating lamp is only possible with a reflector plate.

## *Low Potential Direct Current Lamps*

We have just completed a new direct current lamp which we guarantee will not SEE-SAW. The mechanism is entirely novel. By means of this arrangement the most troublesome feature in running lamps in series is eliminated.

Write us for Prices and Discounts

No. 13.
Inside 7 Ampere 7 Hour Lamp.

**Helios Electric Company**

***PHILADELPHIA, PA.***

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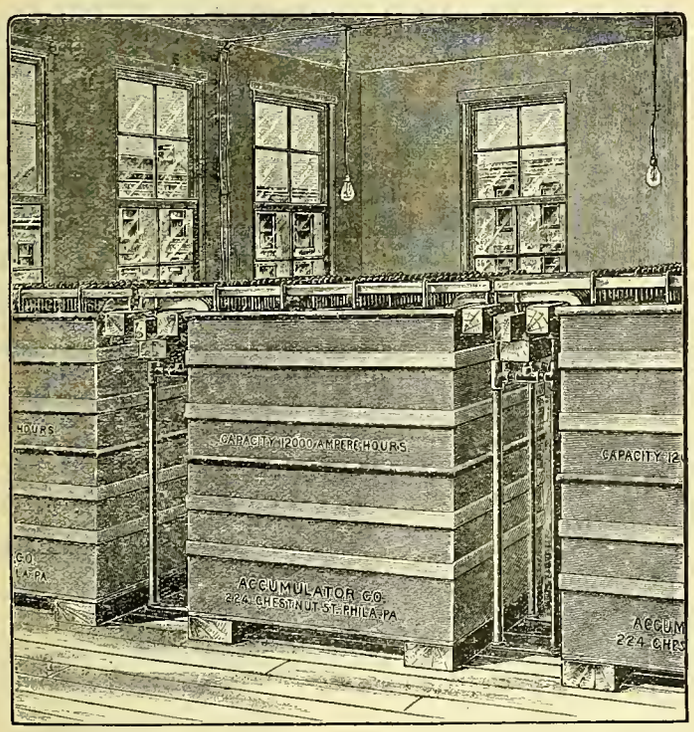
MOUNTAIN ELECTRIC CO., Denver, Col., Agents for Colorado, Utah, Wyoming and New Mexico.
MACHINERY SUPPLY CO., Los Angeles, Cal., Agents for Lower California and Arizona.
Agents for Canada: CANADIAN GENERAL ELECTRIC CO., Ltd. Toronto, Canada.

# Accumulator Company.




## STORAGE BATTERIES FOR CENTRAL STATIONS SUPPLYING LIGHT AND POWER.

New Type with Independent Plates which can be Easily Examined and Replaced without interfering with Charge or Discharge. Capacity from 350 to 12,000 Ampere Hours. No Nuts, Bolts or Screws. Meets all Requirements of Central Stations.

**SPECIAL TYPES FOR VARIOUS PURPOSES.**

*STREET CAR TRACTION,*
*ELECTRIC LAUNCHES,*
*YACHT LIGHTING,*
*PHONOGRAPHS,*
*ELECTRO-PLATING,*
*ELECTRIC WELDING,*
*CAUTERY BATTERIES,*
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For any information regarding types of Cells, weights, dimensions, capacities, prices, discounts, etc., address

**WM. HOOD, 239 La Salle St., Chicago, Ill.**
**CANNETT & COMPANY, Schwartz Building, Providence, R. I.**
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OR

**THE ACCUMULATOR COMPANY, 224 Chestnut St., PHILADELPHIA.**

We do not believe in

# "KNIFE—ING" THE TRADE,

But when we have something particularly good in the line of low prices we cannot refrain from telling our friends about it. This time it is

## JACK-KNIFE SWITCHES.

We have made a special arrangement for the output of a factory on these goods, and are offering the celebrated "C. E. M." Jack-knife and

## MOTOR SWITCHES

At prices considerably below what others are asking for an inferior article. All switches in stock for immediate shipment. Send us a stock order for these and your requirements in

## ELECTRICAL SUPPLIES.

ELECTRIC APPLIANCE COMPANY,
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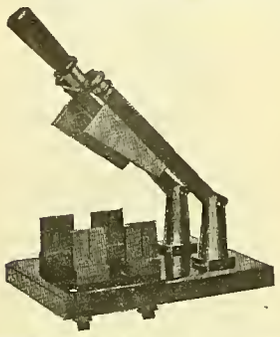
**Switches, Switch-Boards, Tablet-Boards.**



*Estimates and designs furnished on Application.*
Charges reasonable for superior work.
Technic Electrical Works, 129 Bread Street, PHILADELPHIA.

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OCTAGONAL PINE POLES,
NORWAY PINE CROSS-ARMS,
WHITE OAK PINS.
It will pay you to get our prices.
BROWNLEE & CO., - Detroit, Mich.

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**Boswell Storage Battery.**
For Traction Work, Electric Lighting, Electric Launch, Telegraph, Phonograph, Surgical, and for all purposes where Light and Power are required.
Prices on Application.
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The Wirt Dynamo Brush.
Suitable for all Incandescent Dynamos, Plating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.
WALLACE ELECTRIC CO.,
307 Dearborn St., Chicago.

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# W. S. EDWARDS MFG. CO.,

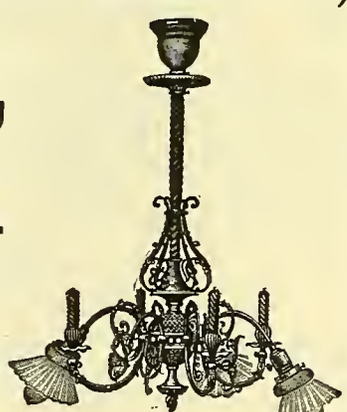
MANUFACTURERS OF

## ELECTROLIERS,

Combination Fixtures,
Electric and Combination Brackets.

EXCLUSIVE DESIGNS.
LOW PRICES.

Our new catalogue of Electric fixtures is now ready. If you buy fixtures send for same.



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**SAMSON SPOT CORD**

For Arc Light and Trolley Cord.
SAMSON CORDAGE WORKS, - BOSTON, MASS.

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The Only Clocks Used in the W. U. Tel. Co. Time Service.
NO WINDING. CORRECTED HOURLY.
SELF-WINDING CLOCK CO.,
26 Broadway, NEW YORK.
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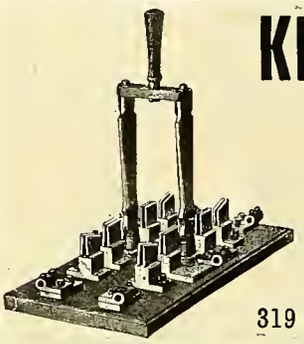

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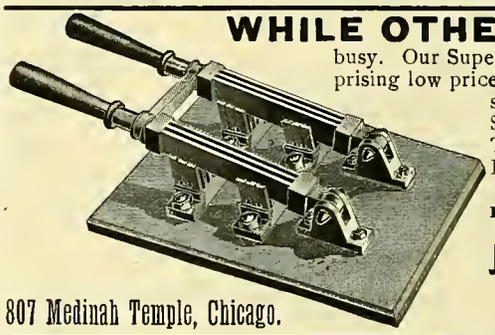

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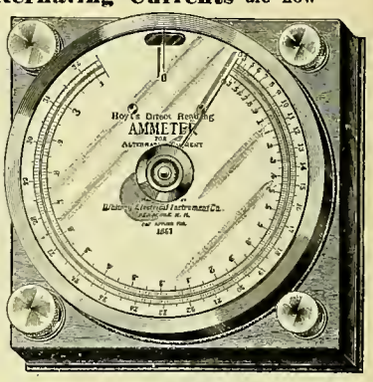


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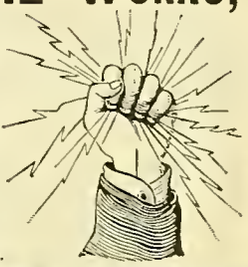

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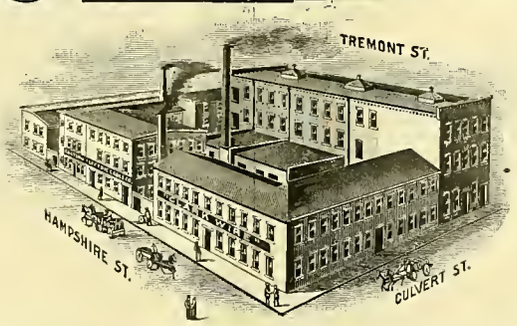


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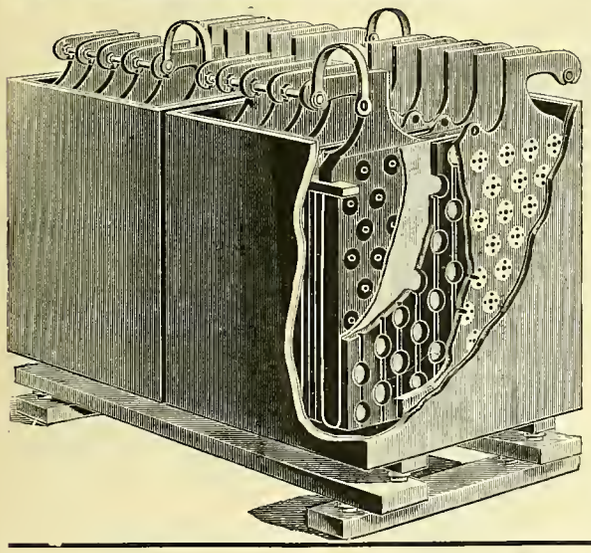

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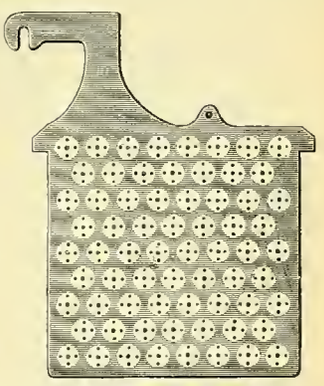

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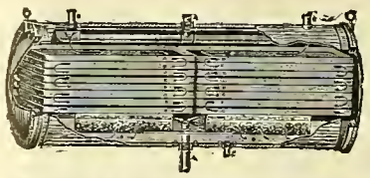

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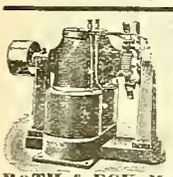

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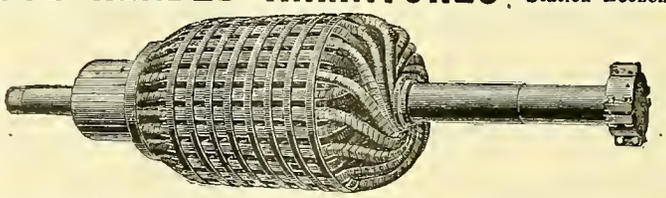

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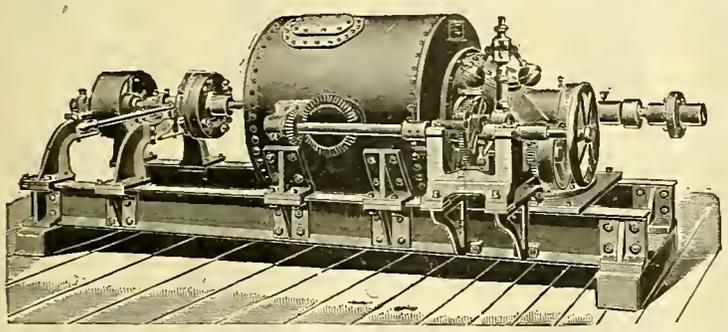

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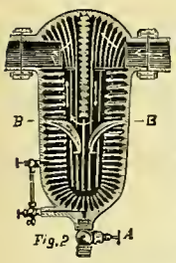


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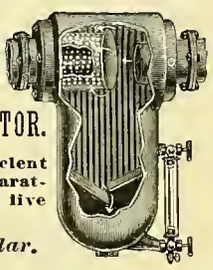

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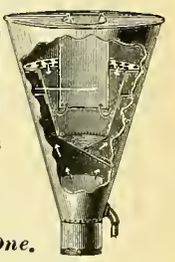

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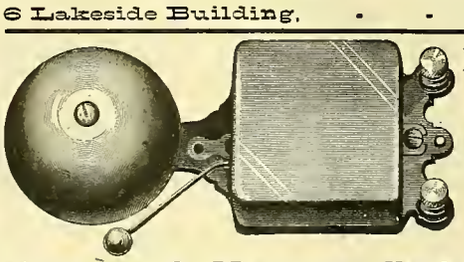

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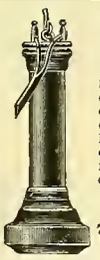

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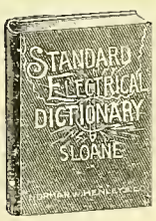


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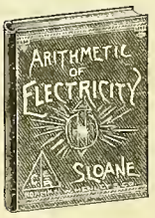


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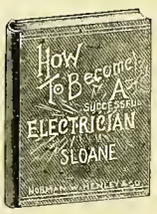


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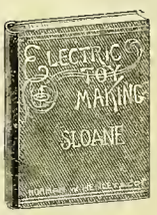


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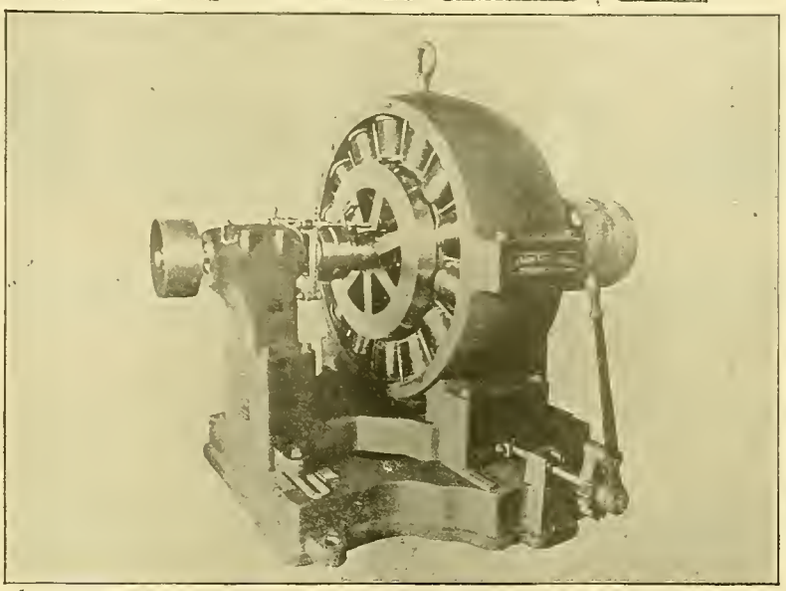

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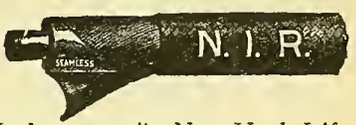


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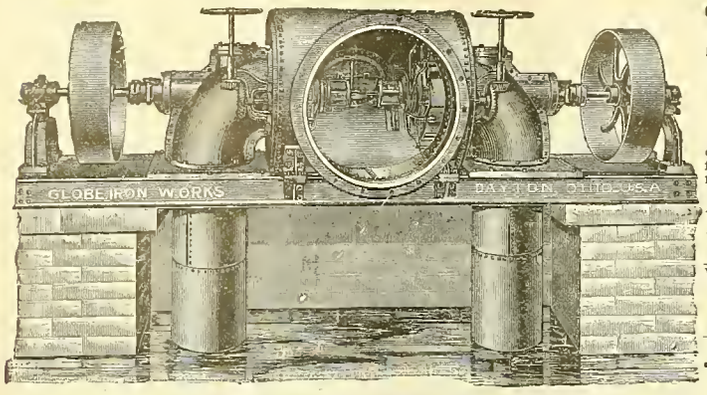


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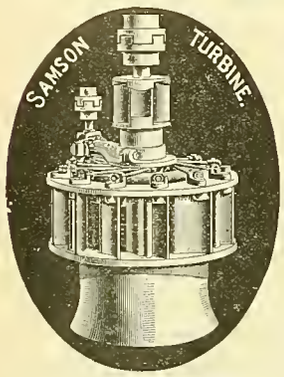


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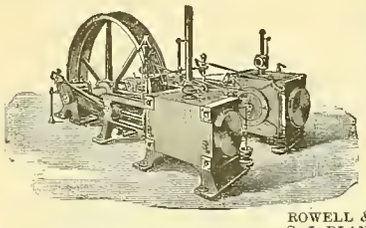

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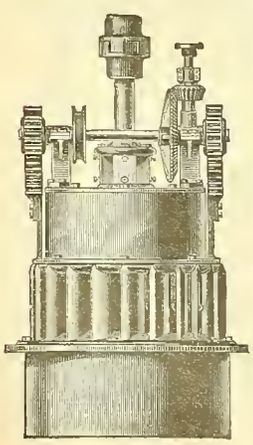

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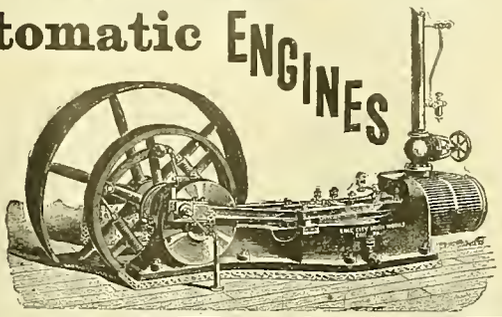

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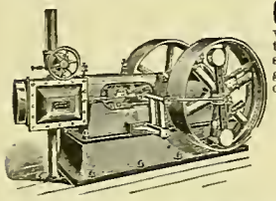

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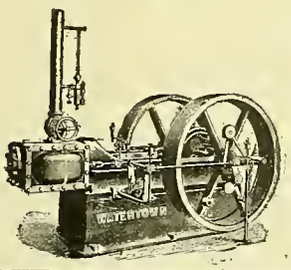

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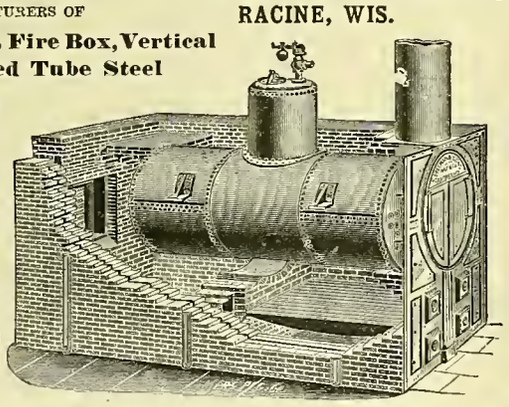

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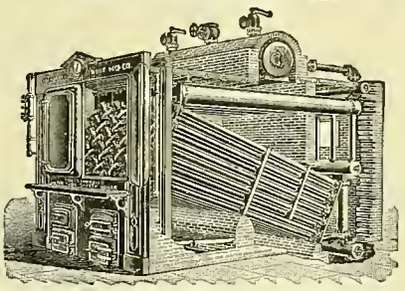

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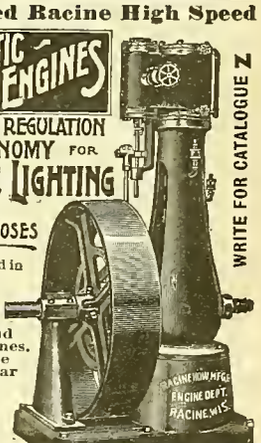

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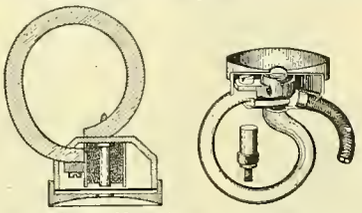
ductor. In the D'Arsonval receiver a curved permanent magnet is used, one pole of which terminates



FIGS. 27 AND 28. D'ARSONVAL RECEIVER.

in a soft iron polepiece that serves as the core of the coil, and the other in an iron box, or cylinder, that

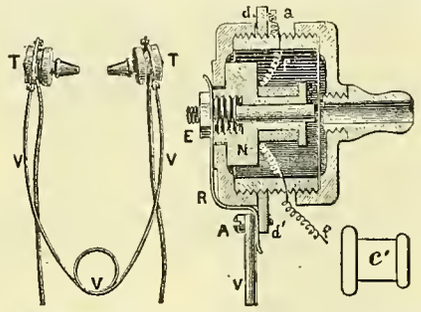



FIG. 29. MERCADIER'S BI-TELEPHONE. *T T* RECEIVERS, *V* SPRING, *N* MAGNET, *E* NUT, *R* STEEL STRIP, *A* SCREW CLAMPING *R* TO *V*, *d d'* METAL COLLAR CLAMPING *V* TO RECEIVER CASE, *f f* TERMINALS OF COIL *a* CONNECTING SCREW, *c'* SOFT RUBBER NIPPLE FOR EARPIECE.

completely encloses the coil. The two poles are magnetically insulated from each other by the wooden case, to the upper part of which the diaphragm is



appeared on the scene with an application for a patent on a microphonic transmitter, and according to the rules of the Patent Office no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbaugh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbangh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad

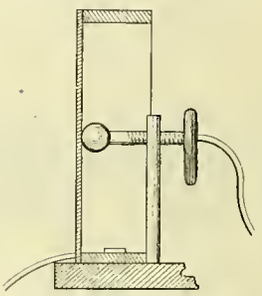


FIG. 44. BERLINER'S FIRST TRANSMITTER.

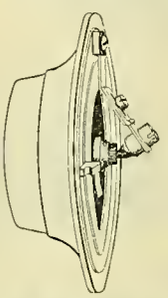


FIG. 45. BERLINER CARBON TRANSMITTER.

principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

78. Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by caus-

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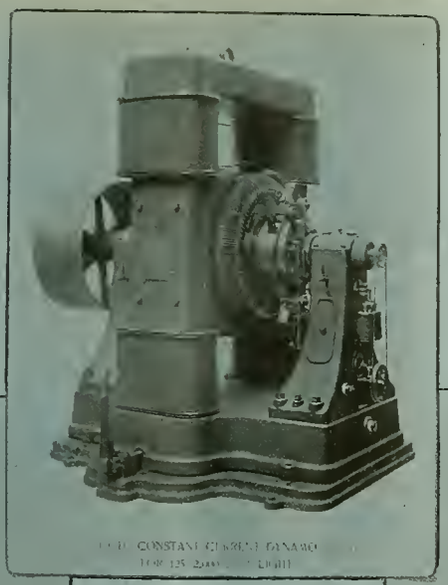

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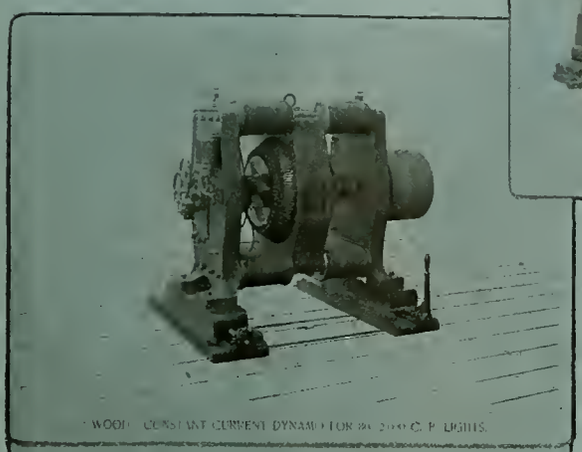

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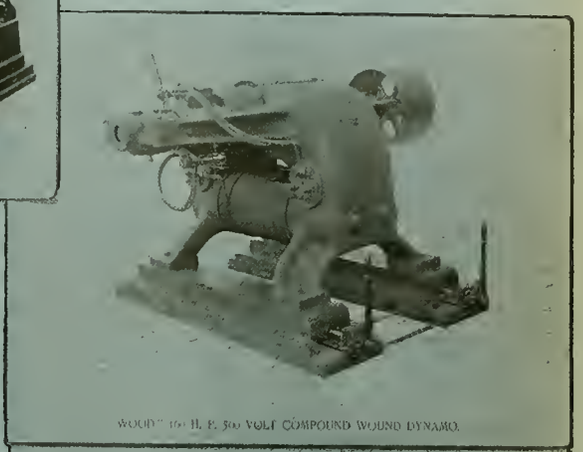

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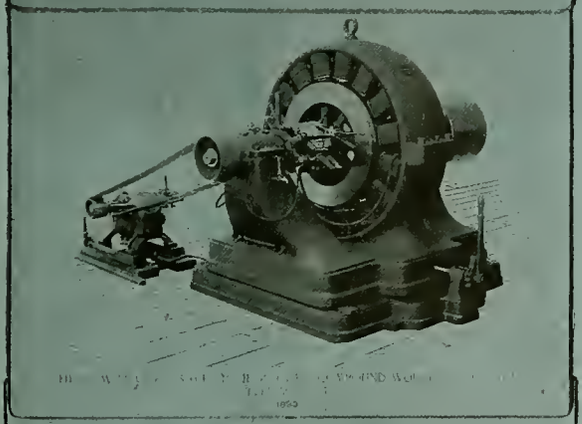

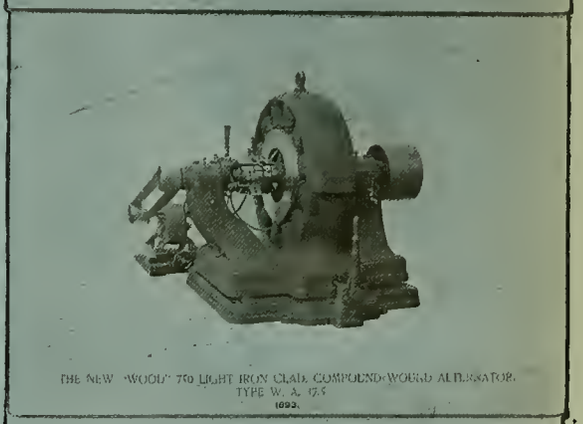

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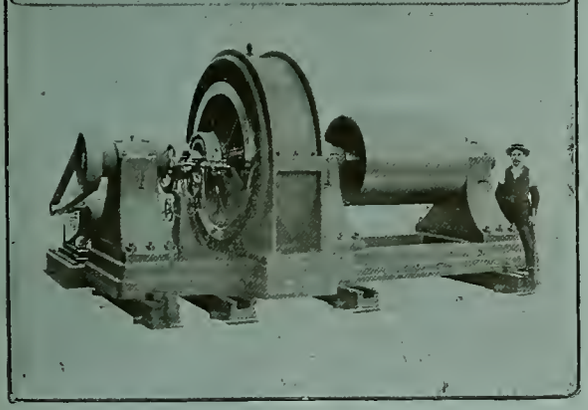

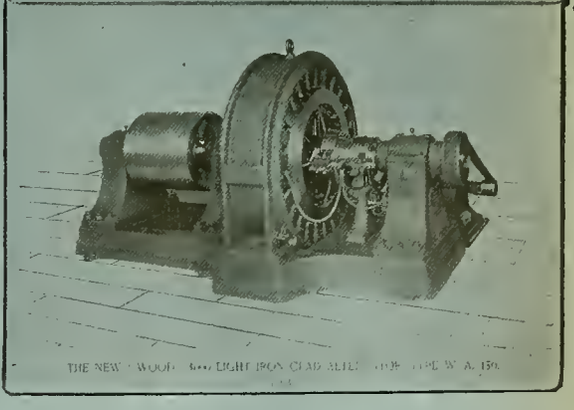

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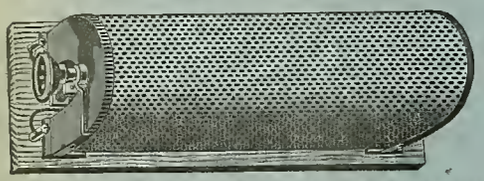

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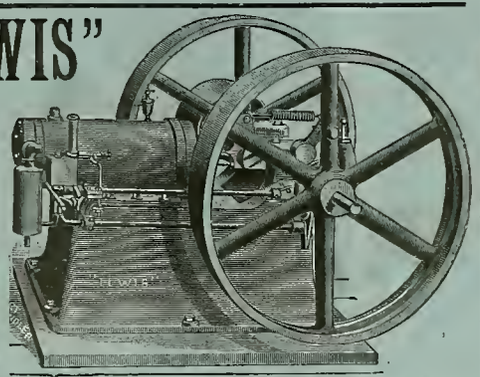

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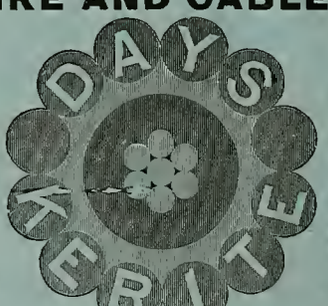


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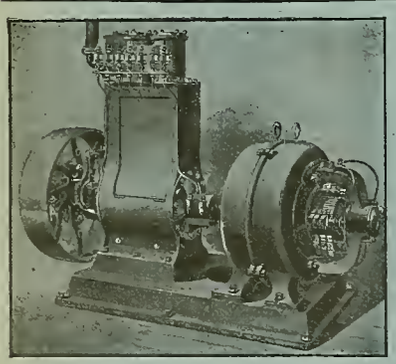

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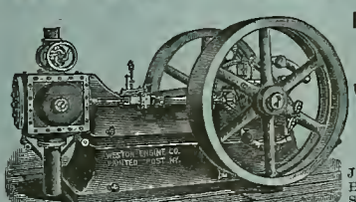

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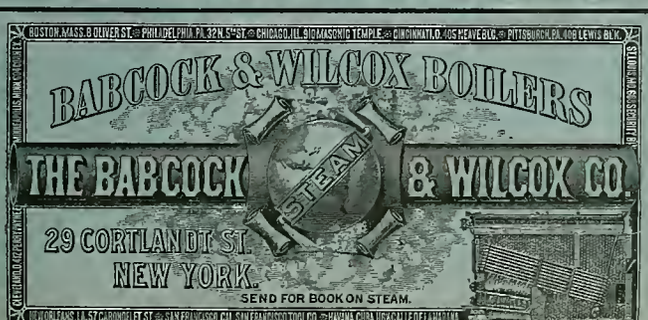


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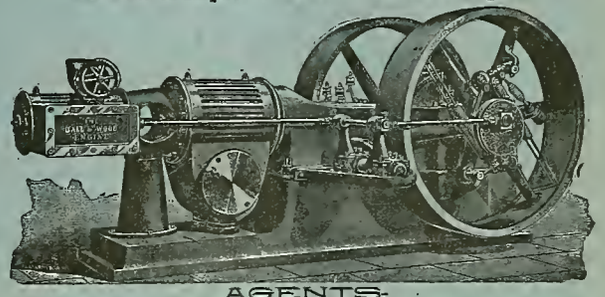

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## CLASSIFIED LIST.


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Accumulator Co.
Boswell & Co., D. E.,
Bradbury-Stone Elec. S. Co.
Cons. Electric St rage Co.
Electric-Power Storage Co.
Electric Storage Battery Co
Haschke & Creelman.
Porter & Buerdorf.

**Annunciators.**
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
Auerbach-Woolverton El. Co.
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
Jennings, A. R.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Arc Light Cord.**
Samson Cordage Wks.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Electric Appliance Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Hayden-Bonker Mfg. Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Partrick & Carter Co.
Phœnix Carbon Mfg. Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Electric Appliance Co.
Huebel & Manger.
Ostrander & Co., W. R.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Western Electric Co.

**Belting.**
Shultz Belting Co
Phœnix Carbon Mfg. Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co., The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electrician Publishing Co.

**Brushes.**
Partridge Carbon Co.
Phœnix Carbon Mfg. Co.

**Burglar Alarms.**
Electric Appliance Co.
Partrick & Carter Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric.** (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Cushing & Morse.
Eastern Electric Cable Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons Points & Plates.**
General Electric Co.
Partridge Carbon Co.
Phœnix Carbon Mfg. Co.
Reisinger, Hugo.
Western Electric Co.

**Clocks, Electric.**
Self-Winding Clock Co.

**Conduits**
Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation
Muncie Elec. Mfg. Co.
Washington Electric Co.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Metropolitan Elec. Co.
National India Rubber Co.
Okonite Co. The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cordage.**
Samson Cordage Wks.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Electric Appliance Co.
Nuttall Co., R. D.
Partrick & Carter Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Cutter Electrical & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Interior Conduit & Ins. Co.
Jennings, A. R.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Elec. Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Palmer Bros.
Roth & Eck.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Economizers.**
Fuel Economizer Co.

**Electric Railways.**
Brush Electric Co
General Electric Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. B.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Rushmore, S. W.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Diamond Electric Co.
Electric Appliance Co.
Interior Conduit & Ins. Co.
Large & Twining.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.
Proctor-Raymond Elec. Co.

**Electraliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Gas.**
Webster Mfg. Co.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Engravers.**
Illinois Engraving Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Interior Conduit & Ins. Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Partrick & Carter Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Jennings, A. R.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. Supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
High & Co., J. Grant.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Elec. Co.
Palmer Bros.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Jaeger Mfg. Co., The.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Induction Coils.**
Splitdorf, C. F.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Elec. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Paragon Insulating Co.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Technic Electrical Wks.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Large & Twining.
Metropolitan Elec. Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac. Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co
Jaeger Mfg. Co., The.
Matoer Electric Co
Metropolitan Electric Co.
New York & Ohio Co.
Partrick & Carter Co.
United Elec. Imp. Co.
Westinghouse Elec & Mfg. Co.

**Lightning Arresters.**
Colgate Co., Geo. L.
Diamond Electric Co.
Electric Appliance Co.
General Electric Co.
Bill, W. S. Electric Co.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery**
Bliss Co., E. W.
Hine & Robertson Co.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

**Motors.**
Bolgiano Mfg. Co.
Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Metropolitan Electric Co.
Palmer Bros.
Royal Electric Co.
Roth & Eck.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co

**Packing.**
Garlock Packing Co.

**Paints.**
Paragon Insulating Co.
Standard Paint Co.

**Patents.**
Gooch, Chas. J.

**Phosphor Bronze.**
Phosphor Bronze Sm. Co. Ltd.

**Platinum.**
Baker & Co.

**Poles.**
Brownlee & Co.
Morris, Tasker & Co.
Nuttall Co., R. D.

**Porcelain.**
Empire China Works.
General Electric Co.
Jennings, A. R.
Phœnix Glass Co.

**Publishers, Electrical.**
Electrician Publishing Co.

**Push Buttons.**
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Partrick & Carter Co.

**Rheostats.**
General Electric Co.
Rushmore, S. W.

**Sal Ammoniac.**
Bayden-Bonker Mfg. Co.
Klipstein, A. & Co.
Law Battery Co

**Second-Hand Electrical Machinery.**
Rushmore S. W.

**Separators**
Goubert Mfg. Co.
Hine & Robertson Co.

**Silk Braid.**
Boston Braid Mfg. Co.

**Slate.**
Independent Electric Co
Jenniugs, A. R.

**Speaking Tubes.**
Electric Appliance Co
Ostrander & Co., W. R.
Partrick & Carter Co

**Speed Indicators.**
Colgate Co., Geo. L.
Diamond Electric Co
Whitney Elec. Instrument Co.

**Steam Heating.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Steam Pumps.**
Worthington, Henry R.

**Storage Batteries.**
Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Cons Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

**Street Cars.**
Brill, J. G. Co.

**Tapes, Insulating.**
American Electrical Works.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus**
Electric Appliance Co.
Partrick & Carter Co.
Western Electric Co.

**Telephones,**
D'Unger Long Dist. Tel. Co.
National Telep. Mfg. Co.
Palmer Bros.
Partrick & Carter Co.
Western Electric Co.
Western Tel. Const. Co.

**Telephone Hooks**
Bradley & Co.

**Transformers.**
Diamond Electric Co.
General Electric Co.
Hornberger Elec. Mfg. Co
Ft. Wayne Elec. Corporation.
Jennings, A. R.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Trolley Cord.**
Samson Cordage Wks.

**Trucks, Electric Car.**
General Electric Co.
Westinghouse El. & Mfg. Co.

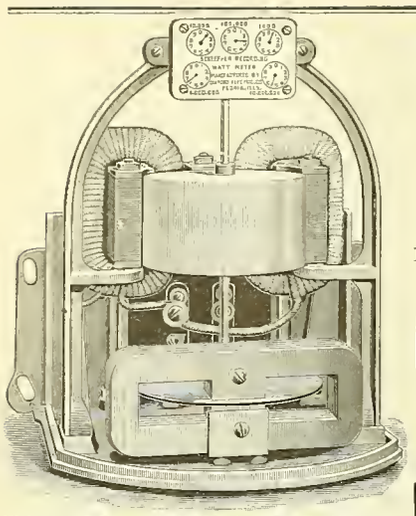
**Turbine Wheels.**
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

**Universities.**
Cor. School of Industrial Sciences
Scientific Machinist Co.

**Varnishes**
Standard Paint Co.

**Water Wheels.**
Leffel & Co., Jas.
Smith, S. Morgan.

**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Electric Appliance Co.
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.



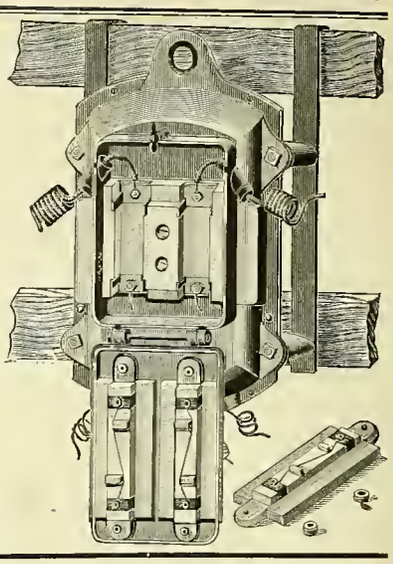
Chicago Office, 1307 Manhattan Building, Central Electric Co., Selling Agents.

# SCHEEFFER'S RECORDING WATT-METER.

For Alternating Circuits. No Commutator. No Brushes.

Registers Direct Actual Power Consumed.

EASILY ADJUSTED. ABSOLUTELY RELIABLE.



# DIAMOND TRANSFORMER.

Simplest, Safest and Best.

FOR ANY VOLTAGE. FOR ALL SYSTEMS.

## DIAMOND ELECTRIC CO., Peoria, Ill.

# THE STANLEY

## Two-Phase System of Alternating Apparatus,

***The first and only complete and perfected system by which light and power can be supplied from the same generator. Power transmission and distribution made practical and commercially successful.***

In construction and operation the entire system is much more simple than any other, either direct or alternating.

The superior efficiency of the generator is in itself a handsome profit to any station.

It is practically self-regulating without the loss of energy involved by compounding or compensating.

The usual sources of trouble and expense in generators have been entirely eliminated from the Stanley; *i.e.* the revolving armature, commutators, collector rings, brushes, etc.

They can be built for any voltage from 110 for isolated lighting to 5,000 for power transmission work.

The motors excel in simplicity of construction; in starting torque and simplicity of starting device; in efficiency in the manner in which they take current in proportion to their load, and in the uniformity of speed under the different conditions of load.

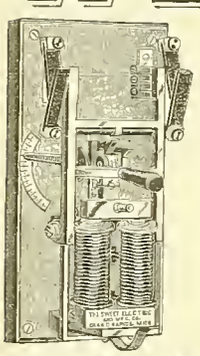
Our transformers insure satisfactory service and the greatest economy. We are prepared to fill all orders promptly, and carry a full stock of transformers in Chicago.

"No practical station man who has seen a Stanley alternator in operation will ever be satisfied with any other."

## STANLEY ELECTRIC MFG. CO., PITTSFIELD, MASS.

**Western Office, 307 Dearborn Street, Chicago, Ill.**

# WIND AND SLEET.

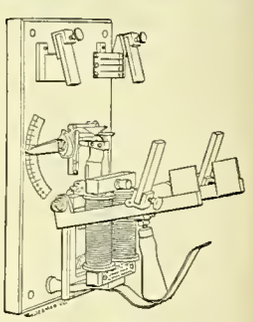


It is out of season for lightning, but you have to be protected from short circuits caused by wind and sleet breaking down your wires, and having them crossed by wires carrying high tension currents.

## OUR SWITCHES FOR THE ALTERNATING CURRENT

continue to go like "hot cakes," and well they ought to, so much protection to life and property for so little outlay; you cannot afford to be without them.

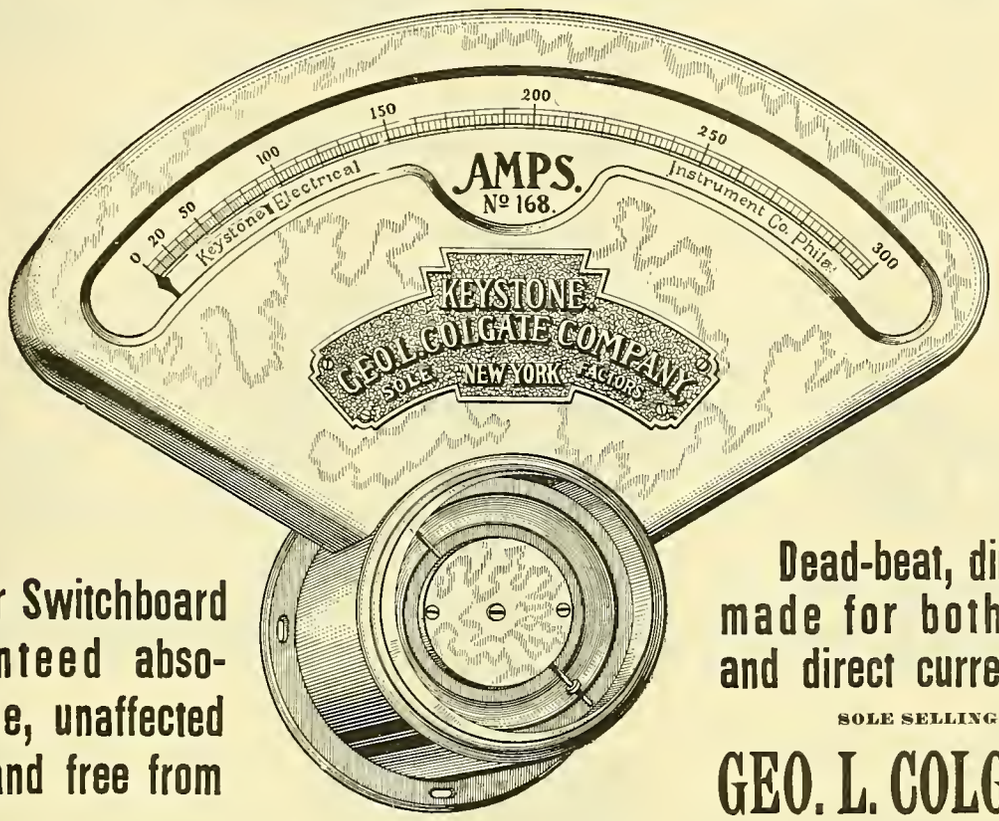
With our device set at 100 amperes you have better protection to your electrical apparatus than from a 10 ampere fuse. Write us at once.



## SWEET ELECTRIC & MFG. CO.,

GRAND RAPIDS, MICH.

# Keystone Voltmeters and Ammeters.




**Designed for Switchboard work. Guaranteed absolutely accurate, unaffected by magnetism and free from heating errors.**

**Dead-beat, direct reading, made for both alternating and direct current.**

SOLE SELLING AGENTS

## GEO. L. COLGATE CO.,

136 Liberty Street, N. Y.

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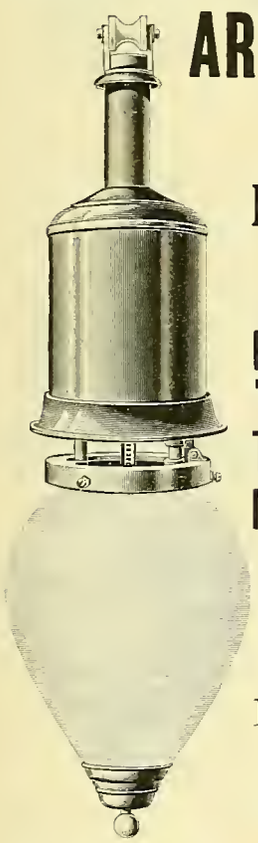
## THE E. C. & S. CO.'S ARC LAMP.



MADE FOR ALL CIRCUITS.

Low Tension, Series Arc,
Street Railway, Alternating.

**Plain and Ornamental.**

**The Easiest Lamp to Trim.**
**It has Universal Carbon Holders.**

Its action, electrically and mechanically, is perfect.

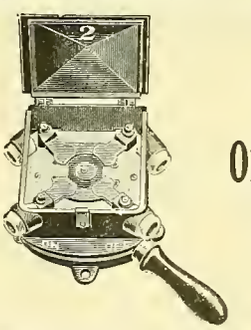
It has fewer operating parts than any lamp on the market.

**SEND FOR CIRCULAR.**

## Wright's Series Circuit Arc Cut-Out.

MANUFACTURED BY
THE HOPE ELECTRIC APPLIANCE CO. Providence, R. I.

The Best Arc Cut-Out Made.



From One to Ten Lights.

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Heavy Porcelain Insulation,
Large Contact Surfaces,
Fire-proof, Water-proof, Storm-proof.

**Send for Circulars of Complete Line of Arc Cut-Outs.**

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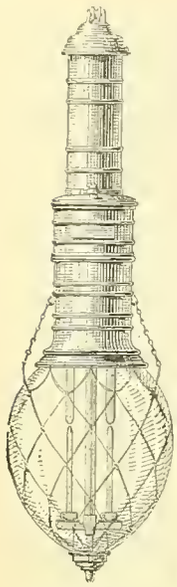

No. 2607
"Twin" Lamp.

# The New "Bergmann" Arc Lamps

**For Constant Potential Circuits.**

## BETTER than all others BECAUSE

THEY HAVE

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AND CONSEQUENTLY CAN

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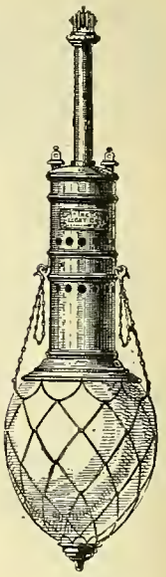

No. 2425
A. C. Lamp.

## GENERAL INCANDESCENT ARC LIGHT CO.,

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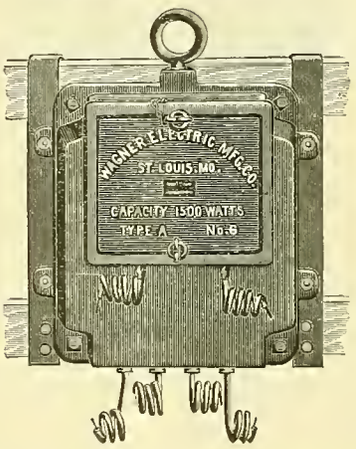


Standard Sizes, 5 Lights to 2,000 Lights.

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To order for any purpose, voltage or capacity.

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For Central Stations and Isolated Plants.

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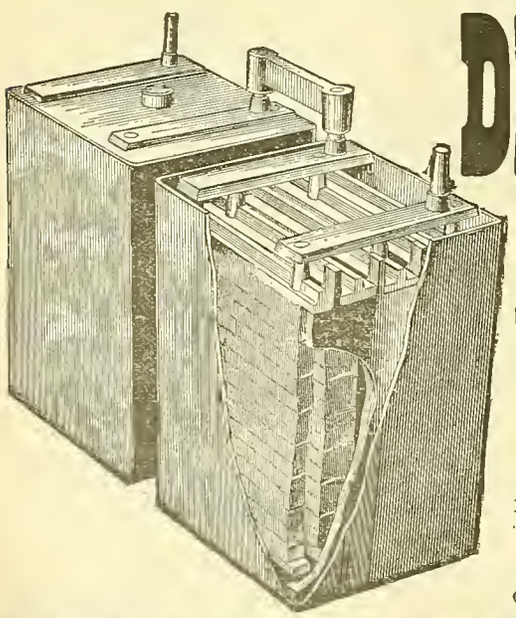

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By all who have used

**STANDARD PLANTÉ BATTERIES.**

Will not **Sulphate** nor **Disintegrate,** and cannot **Buckle.**

**HIGHEST EFFICIENCY, LARGEST DELIVERY, LEAST INTERNAL RESISTANCE.**

**Cells from 10 to 10,000 Ampere-Hour Capacity.**

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Highest Award at the World's Columbian Exposition, Chicago, 1893.

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OR
**MULTIPHASE.**

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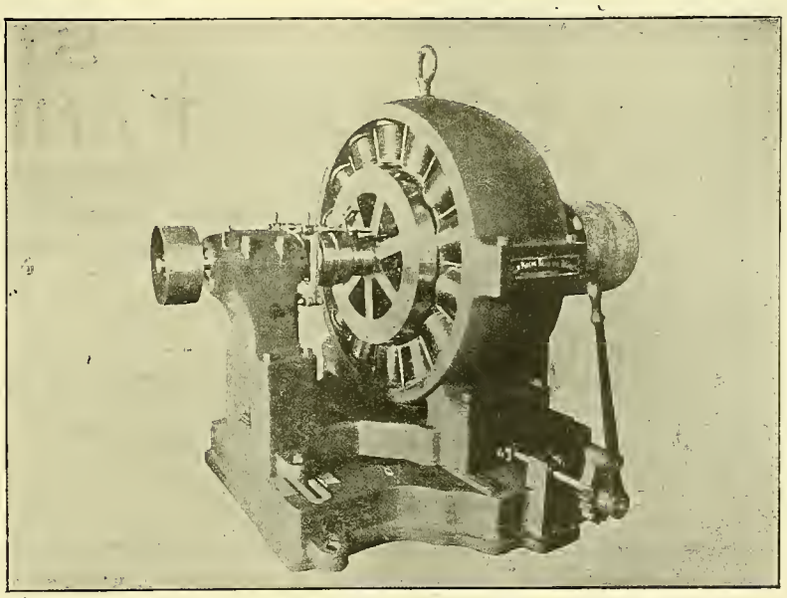

**1,000 Light Alternator.**

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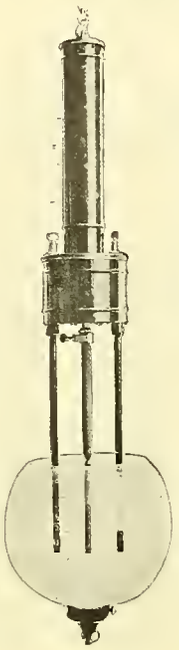
## New Alternating Arc Lamp

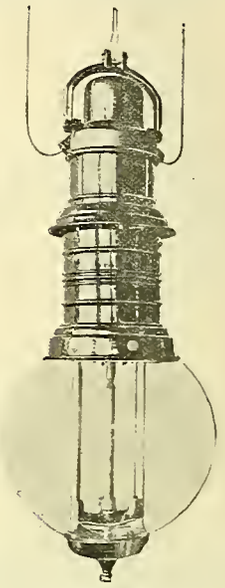
### For Street Lighting

No. 13.
Ioside 7 Ampere 7 Hour Lamp.

New Alternating Lamp 900 c. p, 7 amperes at 28 volts or 4½ amperes at 50 volts, 2¼ amperes at 100 volts. It consumes the energy of 3½ 16 c. p. incandescent lamps. A small alternating lamp is only possible with a reflector plate.



We have just completed a new direct current lamp which we guarantee will not SEE-SAW. The mechanism is entirely novel. By means of this arrangement the most troublesome feature in running lamps in series is eliminated.



No. 10.
Street Lamp, either 12 or 14 hour, to be used in connection with Special 33 Volt Transformer.

*Low Potential*
*Direct Current Lamps*

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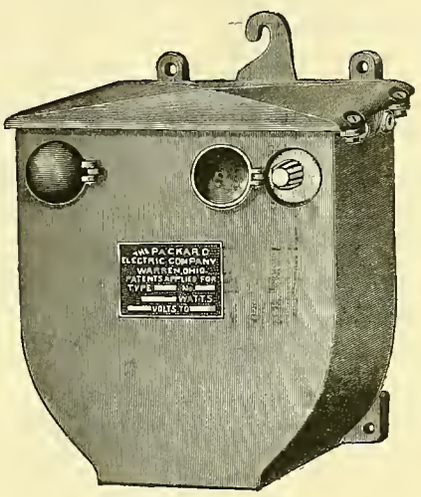
## THE PACKARD TRANSFORMER.

*The Nearest Approach To Perfection*



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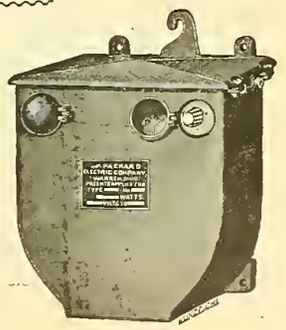

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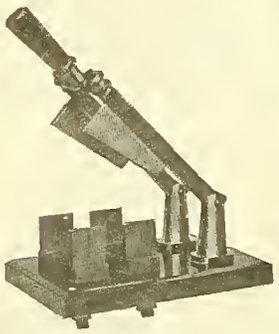

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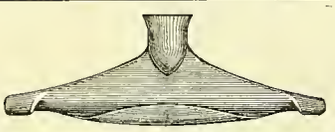

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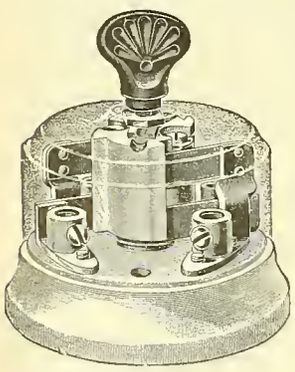

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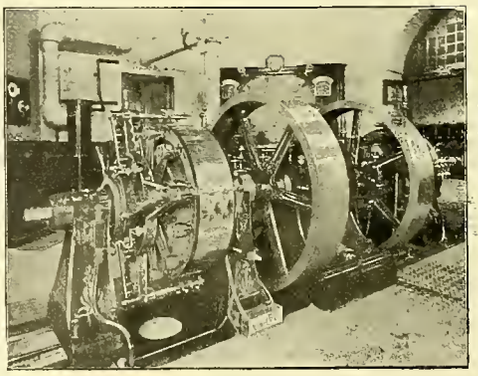

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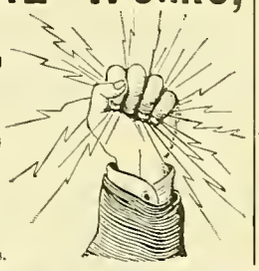

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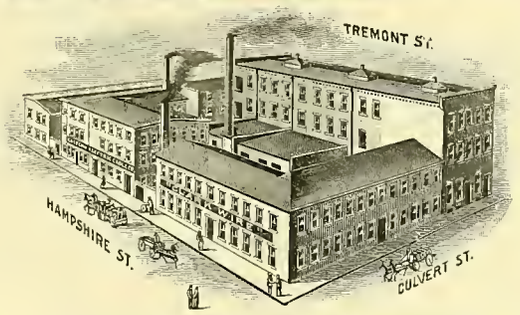


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**OVER 200,000 H. P. IN USE for Railway, Lighting and Motor Service.** World's Fair Diploma and Medal for **best** direct-connected Generator.

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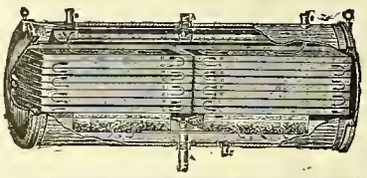

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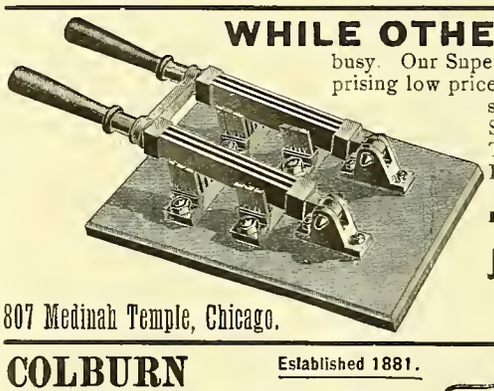

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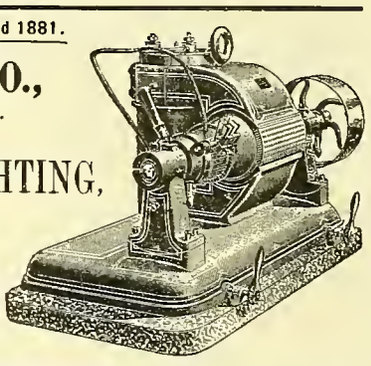

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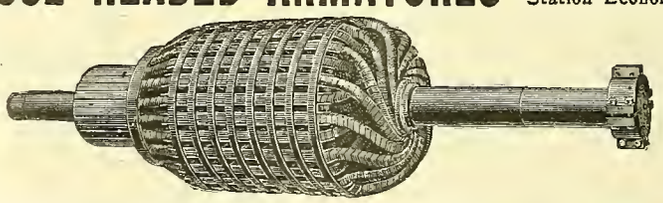

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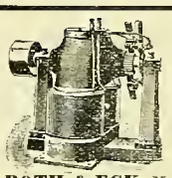

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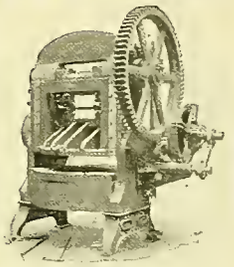

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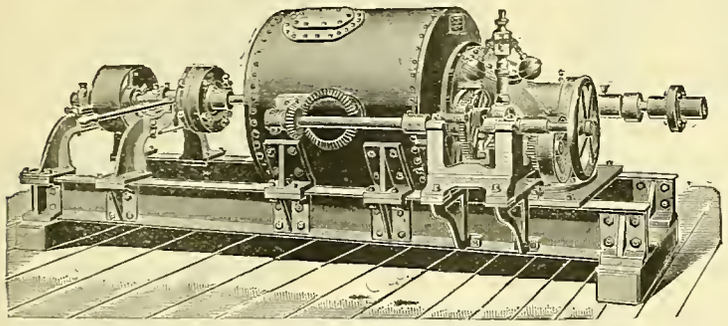

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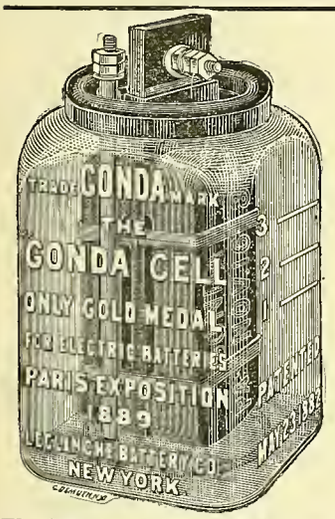


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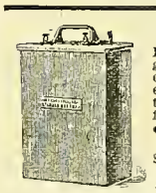

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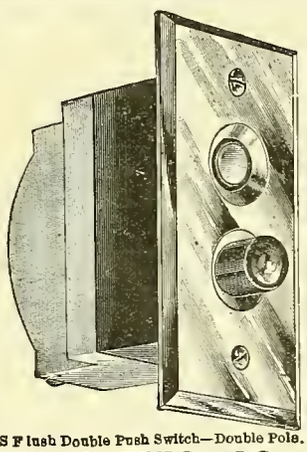
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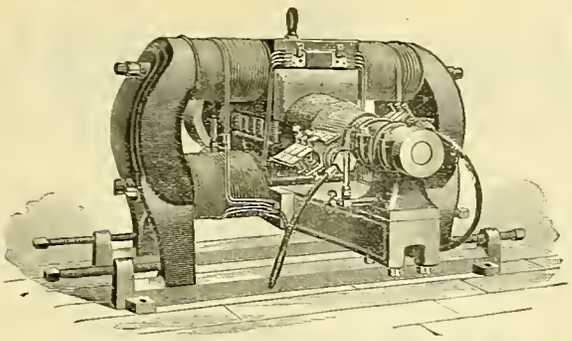

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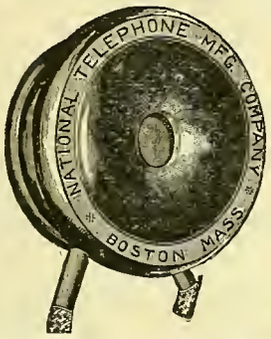


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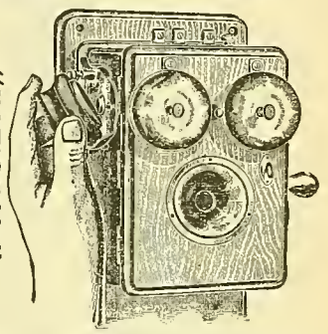

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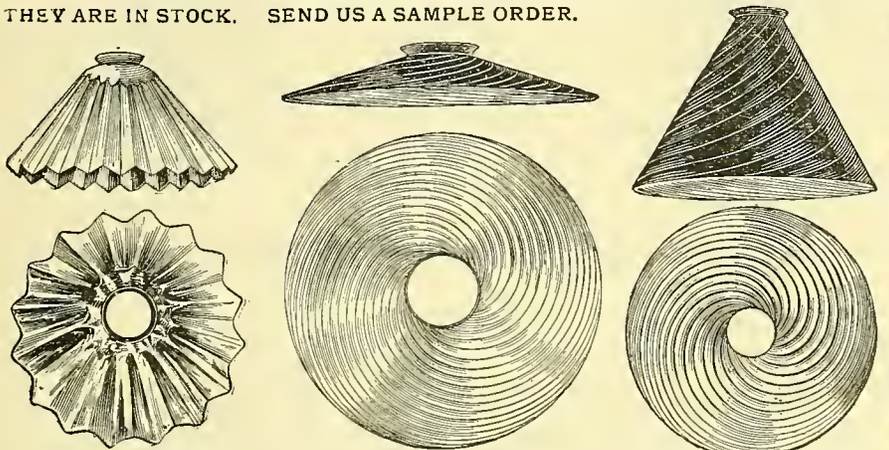

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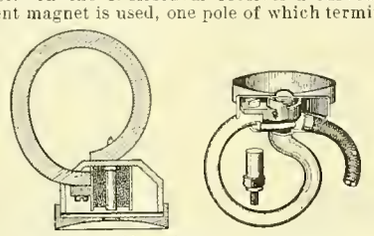
30 TELEPHONE HAND-BOOK

ductor. In the D'Arsonval receiver a curved permanent magnet is used, one pole of which terminates



FIGS. 27 AND 28. D'ARSONVAL RECEIVER.

in a soft iron polepiece that serves as the core of the coil, and the other in an iron box, or cylinder, that

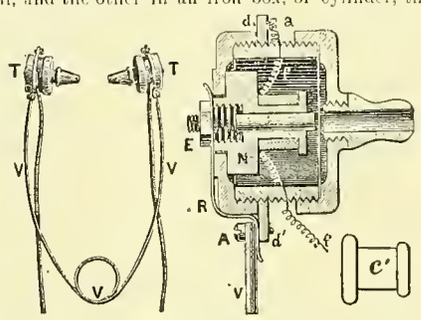



FIG. 29. MERCADIER'S BI-TELEPHONE. *T T* RECEIVERS, *V* SPRING, *N* MAGNET, *E* NUT, *R* STEEL STRIP, *A* SCREW CLAMPING *R* TO *V*, *d d'* METAL COLLAR CLAMPING *V* TO RECEIVER CASE, *f f* TERMINALS OF COIL *a* CONNECTING SCREW, *c'* SOFT RUBBER NIPPLE FOR EARPIECE.

completely encloses the coil. The two poles are magnetically insulated from each other by the wooden case, to the upper part of which the diaphragm is

48 TELEPHONE HAND BOOK.

appeared on the scene with an application for a patent on a microphonic transmitter, and according to the rules of the Patent Office no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbangh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbaugh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad

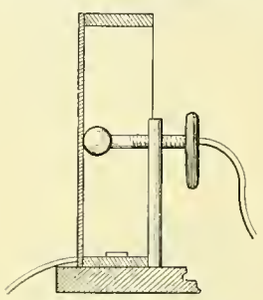


FIG. 44. BERLINER'S FIRST TRANSMITTER.

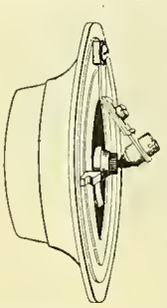


FIG. 45. BERLINER CARBON TRANSMITTER.

principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

78. Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by caus-

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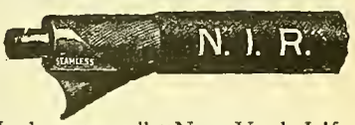


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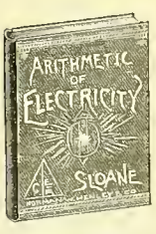


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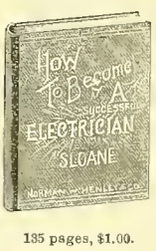


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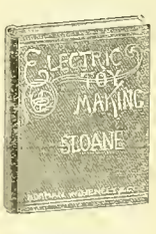


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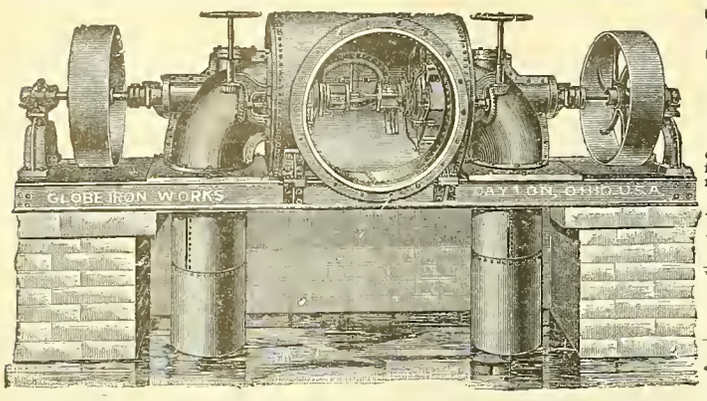


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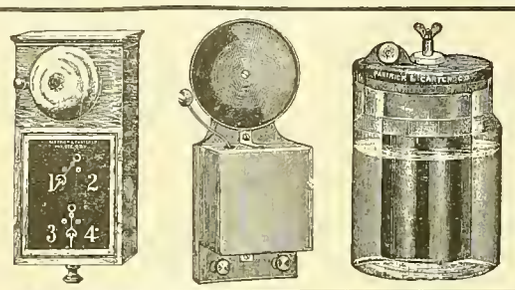

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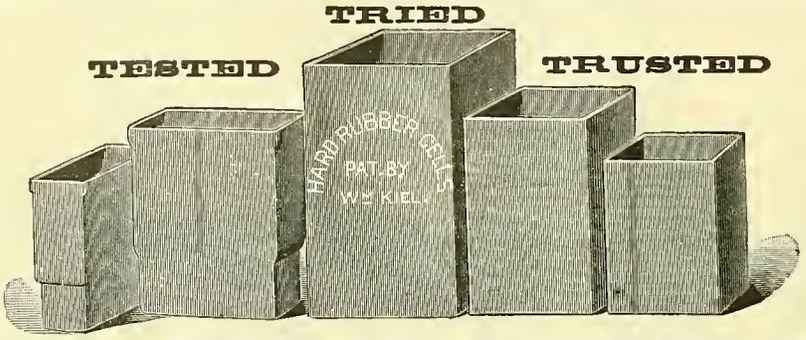


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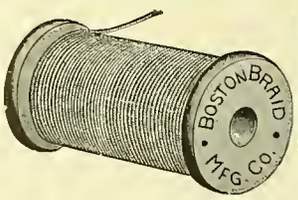


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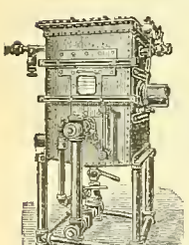

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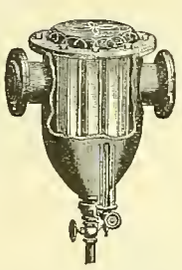

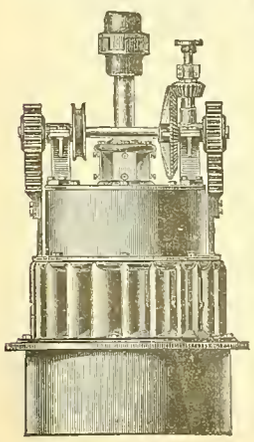

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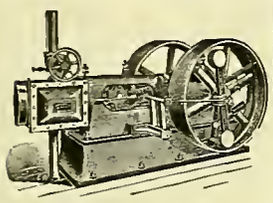

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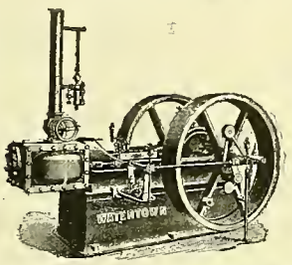

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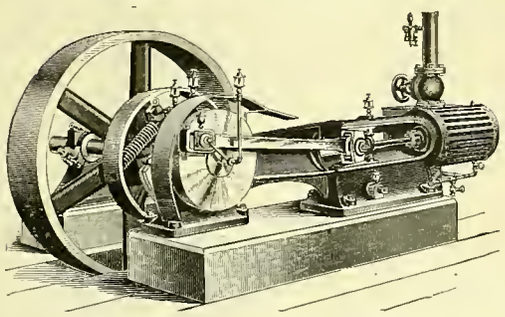

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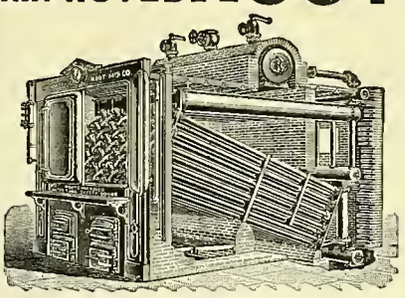

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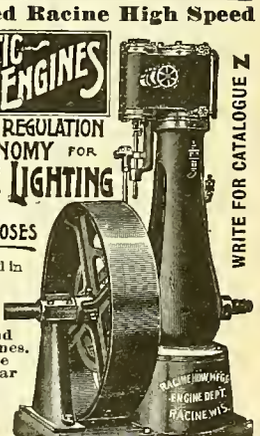


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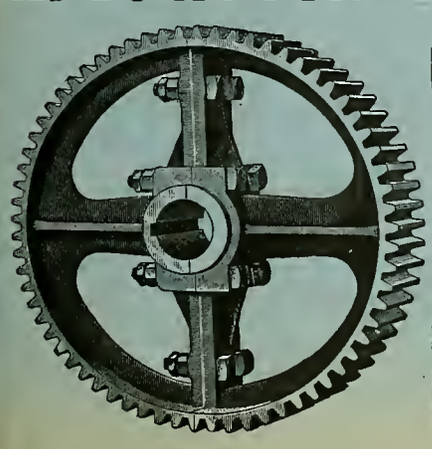

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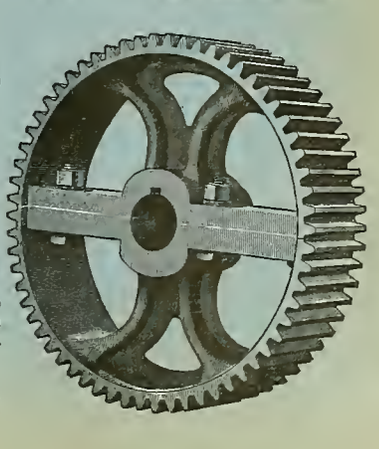

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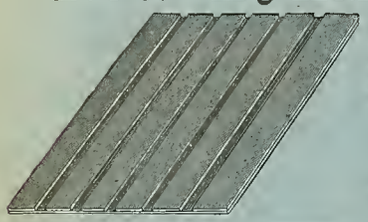

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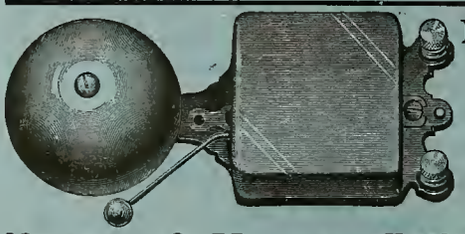

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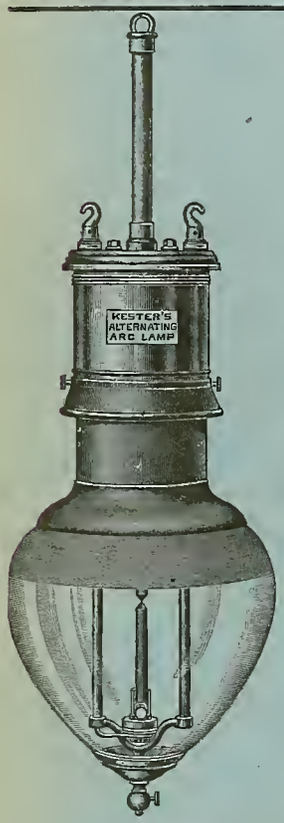


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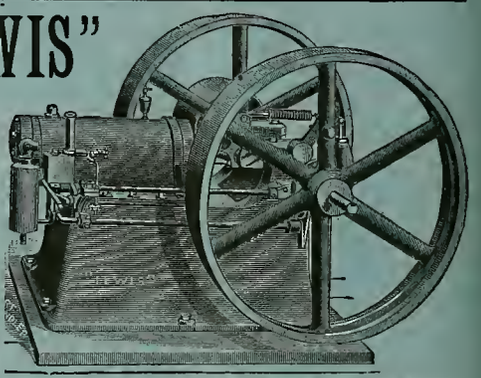

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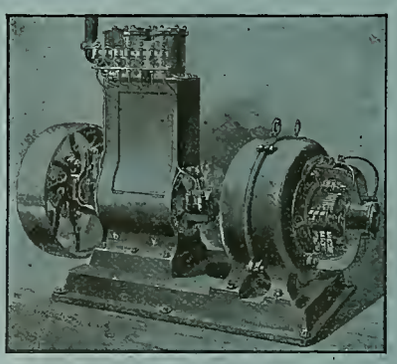

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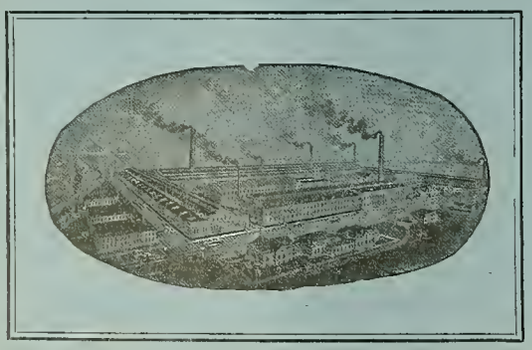

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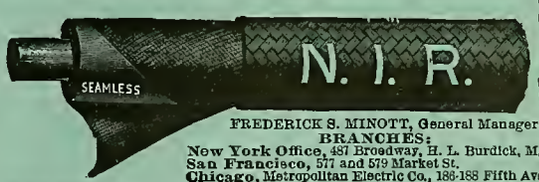


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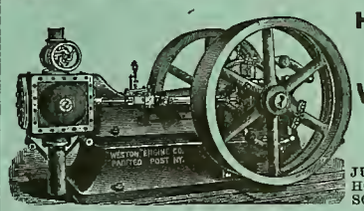

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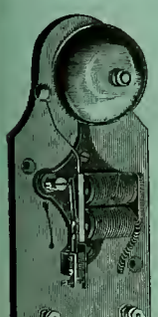

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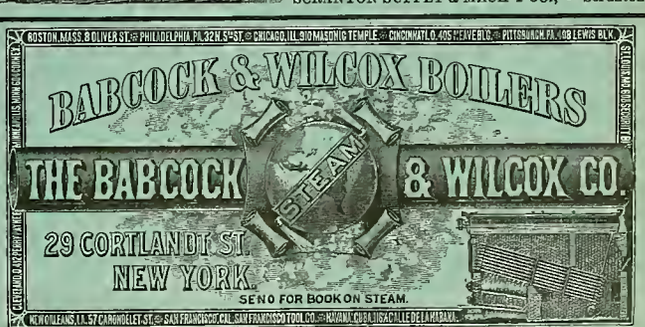


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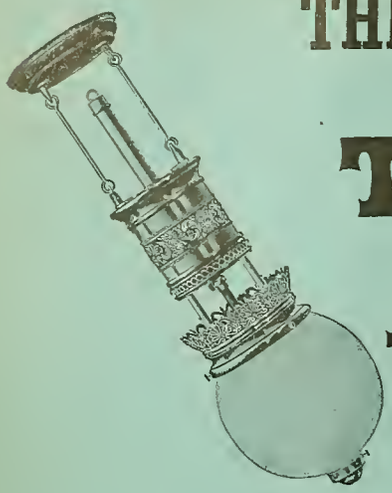

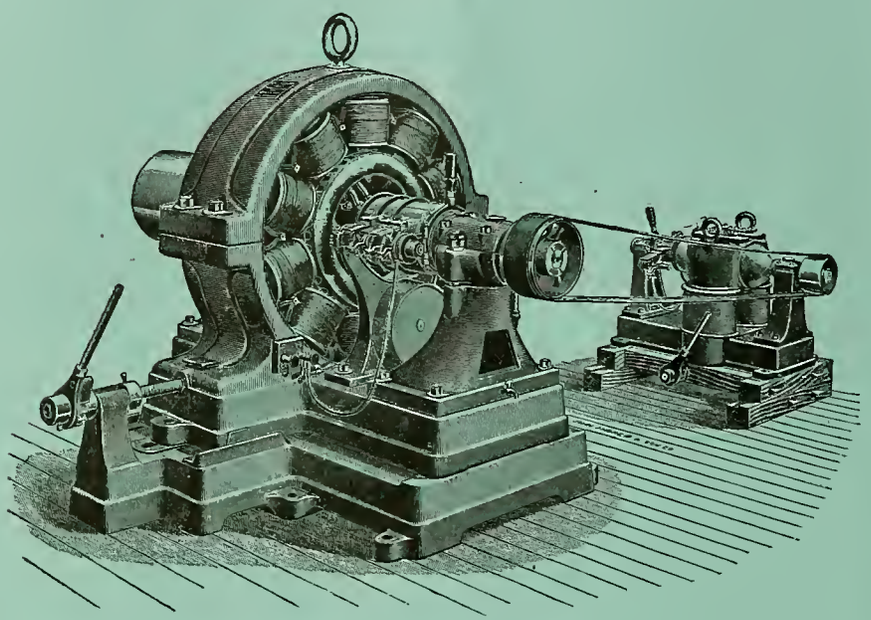

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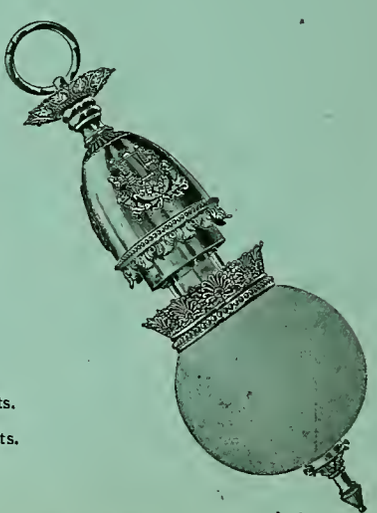

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Webster Mfg. Co. xxii
Webster, Warren & Co. —
Western Electric Co. xvii
Western Elec. Supply Co. —
Western Telephone Construction Co. v, xiii
Westinghouse Elec. and Mfg. Co. xiv
Weston Engine Co. i
Whitney Electrical Instrument Co. x
Worthington, Henry R. —


## CLASSIFIED LIST.


**Accumulators.**
Accumulator Co.
Boswell & Co., D. E.,
Bradbury-Stone Elec. S. Co.
Cons. Electric St rage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Baschke & Creelman.
Porter & Buerdorf.

**Annunciators.**
Chicago Gen'l Fixture Co.
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
Auerbach-Woolverton El. Co.
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
Jennings, A. R.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Arc Light Cord.**
Samson Cordage Wks.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Electric Appliance Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Hayden-Booker Mfg. Co.
Law Battery Co.
Leclanche Battery Co., The.
Metropolitan Electric Co.
Miamisburg Electric Co.
Partrick & Carter Co.
Phœnix Carbon Mfg. Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Electric Appliance Co.
Huebel & Manger.
Ostrander & Co., W. R.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Western Electric Co.

**Belting.**
Shultz Belting Co.
Phœnix Carbon Mfg. Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co., The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electrician Publishing Co.

**Bushes.**
Partridge Carbon Co.
Phœnix Carbon Mfg. Co.

**Burglar Alarms.**
Electric Appliance Co.
Partrick & Carter Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric.** (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Cushing & Morse.
Eastern Electric Cable Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons, Points & Plates.**
General Electric Co.
Partridge Carbon Co.
Phœnix Carbon Mfg. Co.
Reisinger, Hugo.
Western Electric Co.

**Clocks, Electric.**
Self-Winding Clock Co.

**Conduits.**
Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Washington Electric Co.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Metropolitan Elec. Co.
National India Rubber Co.
Okonite Co. The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cordage.**
Samson Cordage Wks.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Electric Appliance Co.
Nuttall Co., R. D.
Partrick & Carter Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Cutter Electrical & Mfg. Co.
Diamond Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Interior Conduit & Ins. Co.
Jennings, A. R.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Elec. Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Palmer Bros.
Roth & Eck.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Economizers.**
Fuel Economizer Co.

**Electric Railways.**
Brush Electric Co.
General Electric Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Rushmore, S. W.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Diamond Electric Co.
Electric Appliance Co.
Interior Conduit & Ins. Co.
Large & Twining.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co
Sweet Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.
Proctor-Raymond Elec. Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Gas.**
Webster Mfg. Co.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Fan Outfits.**
Bolgiano Mfg. Co.
Interior Conduit & Ins. Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Partrick & Carter Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Jennings, A. R.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. Supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Cutter Electrical & Mfg. Co.
Electric Appliance Co.
General Electric Co.
High & Co., J. Grant.
Holtzer-Caoot Electric Co.
Interior Conduit & Ins. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Elec. Co.
Palmer Bros.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Jaeger Mfg. Co., The.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Induction Coils.**
Splitdorf, C. F.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Elec. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Paragon Insulating Co.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Technic Electrical Wks.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Cushing & Morse.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Large & Twining.
Metropolitan Elec. Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Jaeger Mfg. Co., The.
Mather Electric Co.
Metropolitan Electric Co.
New York & Onio Co.
Partrick & Carter Co.
United Elec. Imp. Co.
Westinghouse Elec. & Mfg. Co.

**Lightning Arresters.**
Colgate Co., Geo. L.
Diamond Electric Co.
Electric Appliance Co.
General Electric Co.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery.**
Bliss Co., E. W.
Hine & Robertson Co.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

**Motors.**
Bolgiano Mfg. Co.
Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Metropolitan Electric Co.
Palmer Bros.
Royal Electric Co.
Roth & Eck.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co

**Packing.**
Garlock Packing Co.

**Paints.**
Paragon Insulating Co.
Standard Paint Co.

**Patents.**
Gooch, Chas. J.

**Phosphor Bronze.**
Phosphor Bronze Sm. Co. Ltd

**Platinum.**
Baker & Co.

**Poles.**
Brownlee & Co.
Morris, Tasker & Co.
Nuttall Co., R. D.

**Porcelain.**
Empire China Works.
General Electric Co.
Jennings, A. R.
Phœnix Glass Co.

**Publishers, Electrical.**
Electrician Publishing Co.

**Push Buttons.**
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Partrick & Carter Co.

**Rheostats.**
General Electric Co.
Rushmore, S. W.

**Sal Ammoniac.**
Hayden-Booker Mfg. Co.
Klipstein, A. & Co.
Law Battery Co.

**Second-Hand Electrical Machinery.**
Rushmore S. W.

**Separators**
Goubert Mfg. Co.
Hine & Robertson Co.

**Silk Braid**
Boston Braid Mfg. Co.

**Slate.**
Independent Electric Co
Jennings, A. R.

**Speaking Tubes.**
Electric Appliance Co
Ostrander & Co., W. R.
Partrick & Carter Co

**Speed Indicators**
Colgate Co., Geo. L.
Diamond Electric Co.
Whitney Elec. Instrument Co.

**Steam Heating.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Steam Pumps.**
Worthington, Henry R.

**Storage Batteries.**
Accumulator Co.
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

**Street Cars.**
Brill, J. G. Co.

**Tapes, Insulating.**
American Electrical Works.
Cushing & Morse.
Electric Appliance Co.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okoulte Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
Electric Appliance Co.
Partrick & Carter Co.
Western Electric Co.

**Telephones.**
O'Unger Long Dist. Tel. Co.
National Telep. Mfg. Co.
Palmer Bros.
Partrick & Carter Co.
Western Electric Co.
Western Tel. Const. Co.

**Telephone Hooks.**
Bradley & Co.

**Transformers.**
Diamond Electric Co.
General Electric Co.
Hornberger Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Jennings, A. R.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Trolley Cord.**
Samson Cordage Wks.

**Trucks, Electric Car.**
General Electric Co.
Westinghouse El. & Mfg. Co.

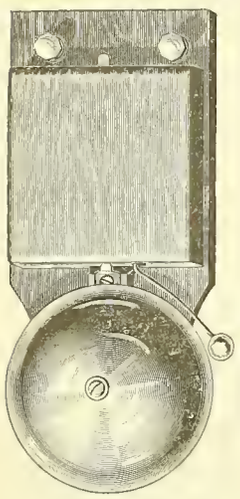
**Turbine Wheels.**
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

**Universities.**
Cor. School of Industrial Sciences.
Scientific Machinist Co.

**Varnishes.**
Standard Paint Co.

**Water Wheels.**
Leffel & Co, Jas.
Smith, S. Morgan.

**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Electric Appliance Co.
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.



# "REX" WOOD BOX BELL.

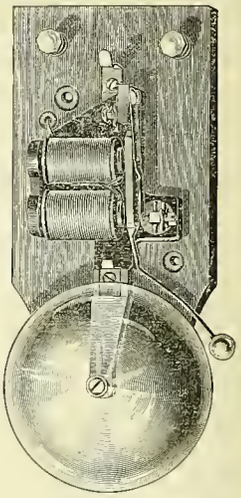
THE CONTRACTOR'S FRIEND.

*REASONABLE in Price and RELIABLE in Construction.*

Sizes 2½, 3, 4, 5 and 6 inches and Fancy Gongs.

The Contact Post or Binding Post Cannot Turn or Loosen; Double Adjustment.

NEW YORK—All the Leading Supply Houses
BOSTON—Pettingell-Andrews Co.; Thompson-Brown Electric Co.; Anchor Electric Co.
CHICAGO—Central Electric Co.
PHILADELPHIA—Lewis Rice, Mfr's. Agent, 1213 Filbert St.
CINCINNATI—The Jones Bros. Electric Co.
ST. LOUIS—Commercial Electrical Supply Co.
PITTSBURG—Robbins Electric Co.; Electric Supply & Const. Co.



## PROCTOR-RAYMOND ELECTRIC CO.,

ROCHESTER, N. Y.

---

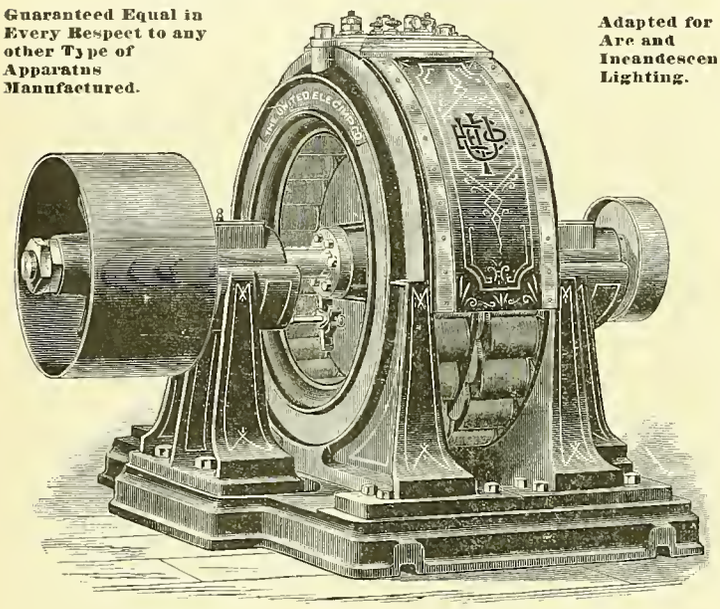
SINGLE OR MULTIPHASE,

## Alternating Current Generators,

For Central Station Equipment.

Guaranteed Equal in Every Respect to any other Type of Apparatus Manufactured.

Adapted for Arc and Incandescent Lighting.



Slow Speed and Close Regulation.

Standard of Simplicity and Durability.

ALSO

Direct Current Apparatus for Lighting Factories, Public Buildings and Isolated Plants.

Improved Long Distance Series Incandescent Apparatus for Street and Commercial Illumination.

Incandescent Lamps and Sockets for use on Arc Light Circuits.

**Correspondence Solicited.**

## THE UNITED ELECTRIC IMPROVEMENT CO.,

19th St. and Alleghany Ave., Philadelphia, Pa.

---

## ARC LAMPS FOR INCANDESCENT

Circuits, Both Alternating and Direct.

Standard "Ward" Lamps, $10 Each.

TWO IN SERIES ON 110 VOLTS.

Globe and Resistance, $2.00 extra per lamp.

## A Complete Line

Of ENTIRELY NEW Arc Lamps.

SIMPLEST. STRONGEST. SUREST FEED.

Easiest and Cheapest to Maintain.

*SPECIAL LAMPS OF ALL KINDS.*

WRITE US FOR CIRCULARS.

We carry a stock of FIDELITY carbons and IMPORTED CORED carbons, which we are selling at reduced prices.

USERS OF ARC LAMPS SHOULD WRITE US FOR PRICES.

## Electric Construction & Supply Co.,

18 Cortlandt Street, New York.
(Established 1881.)

Wallace Electric Co., Agents, 307 Dearborn Street, Chicago, Ill.

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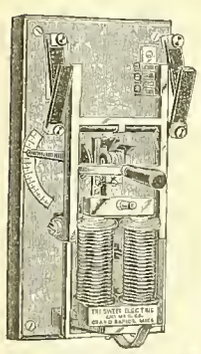
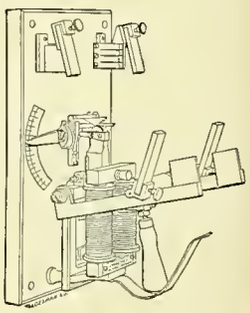
# Hot Stuff.



No! we make the final break off from carbons so that it is impossible to get heat enough to fuse points of your copper contact plates; no filing off of rough points, no hanging on after you have had a short circuit or over load, bound to work as easily after opening 1,000 times as it does when opened the first time.

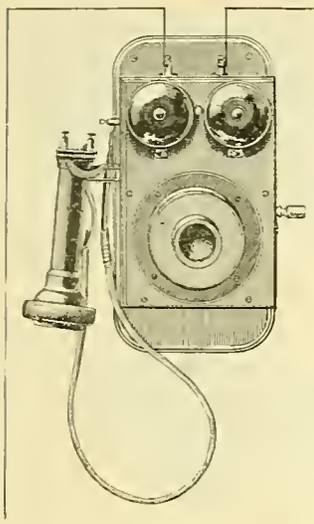
WE KNOW YOU NEED OUR CIRCUIT BREAKER, and do not see why you should delay writing us any longer. One burn out will pay for a dozen of our instruments. To be used on the Alternating or Direct Current Systems.



WRITE US AT ONCE.

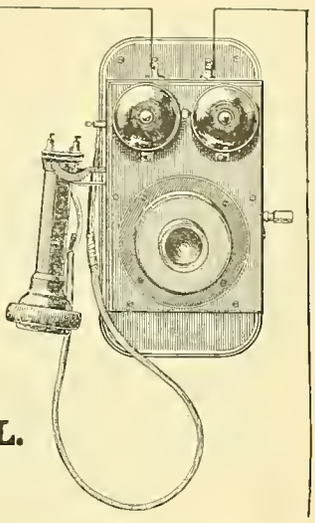
## SWEET ELECTRIC & MFG. CO.,

GRAND RAPIDS, MICH.



# WESTERN TELEPHONE CONSTRUCTION COMPANY,

CHICAGO, ILL.



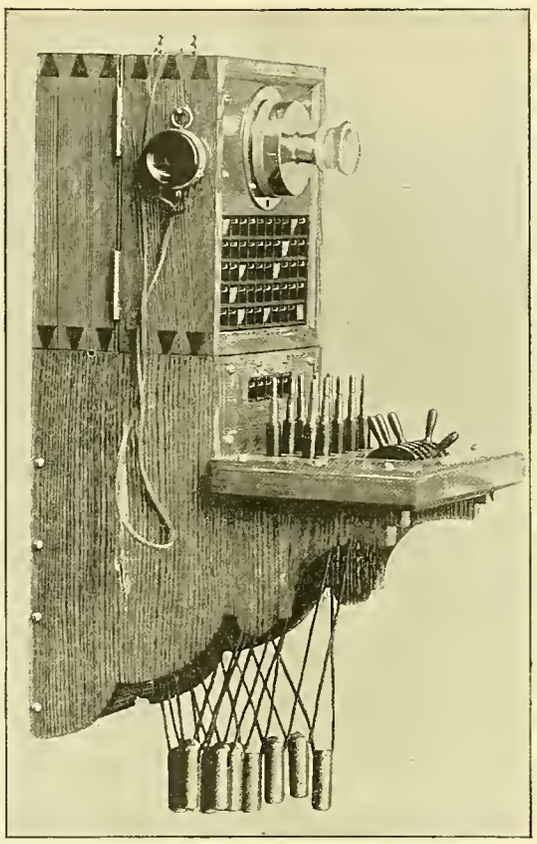
## TELEPHONES.

That our **Dynamic Telephones** are giving perfect satisfaction is fully proven by the demand for them.

### Some of the Exchanges Operating:

Van Wert, Ohio, Telephone Co.
Webster City, Ia., E. H. Martin Tel. Co.
Santa Fe, N. M., I. Sparks, Gen'l Mgr.
Beaumont, Texas, E. L. Bacon, Pres.
Cambridge, O., Hoyle & Scott, Proprs.
Maryville, Tenn., J. B. Cox, Propr.
Navasota, Tex., Navasota Tel. Co.
Hartford City, Ind., H. O. Miller, Owner.
Russellville, Ky., T. C. Clark, Owner.
Palestine, Tex., L. C. Ketcham.
Greensboro, N. C., Greensboro Tel. Co.
Shelbyville, Ills., Dr. J. W. Hamer, Gen'l Mgr.
Jefferson, Tex., W. K. Henderson, Gen'l Mgr.
Fostoria, O., Citizens Tel. and Mesgr Co. of Tiffin, O.
Columbia, Mo., Truitt & Fyfer, Owners.
Decatur, Ind., Citizens' Tel. Co.,
Calvert, Tex., L. T. Fuller.
Grand Rapids, Minn., Arrol & Fargo, Owners.
Manistique, Mich., Chicago Lumber Co.
Salisbury, N. C., T. J. McAdoo, Owner.
Henderson, Tex., Geo. W. Smith.
Chariton, Ia., Chariton Tel. Co.
Petaluma, Cal., W. S. P. Tel. Co.
Forman, N. D., Dr. W. W. Bradley, Owner.
Washington, Ia., L. D. Robinson, Sec'y.
Patlatka, Fla., Patlatka Tel. Co.
Waxabatchie, Tex., Teutsch & Penn.

All the other so-called telephone companies combined (except Bell Co.) cannot show as many public exchanges as the above list. We have many others.



## SWITCHBOARDS.

The same is true of our No. 1 **Switchboard.** We refer with confidence to some of the users of our apparatus.

### Some Users of Private Plants:

C. B. & Q. Ry, W. W. Ryder, Supt. Tels.
The Johnson Co., Johnstown, Pa.
Paine Lumber Co., Oshkosh, Wis.
Pabst Brewing Co., Milwaukee, Wis.
Hospital for Epileptics, Gallipolis, O.
Geo. W. Davidson, Warrensburgh, N. Y.
Clement, Bane & Co., Chicago.
Whitman & Barnes Mfg. Co., Akron, O., and So. Pullman, Ills.
Armour & Co., Chicago.
Rigby & Flower, Pittsburg, Pa.
Chicago & Northwestern Ry., Chicago.
Riverside Water Co., Riverside, Cal.
Lykens Tel. & Tel. Co., Elizabethville, Pa.
Washburn-Crosby Co., Minneapolis, Minn.
Central Electric Co., Chicago.
J. E. Eldred, Milwaukee, Wis.
North American Telegraph Co., Minneapolis, Minn.
Coxe Bros Coal Co., Chicago.
Allentown Electric Co., Allentown, Pa.
Southern El. Mfg. & Supply Co., New Orleans, La.
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We guarantee our apparatus in every respect, especially against infringement of patents, and we are not in the market with stock or shares.

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## TELEPHONES AND TELEPHONIC APPARATUS.

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The company is prepared to do all kinds of construction work relating to Telephones and to furnish experts to those who desire to install its apparatus.

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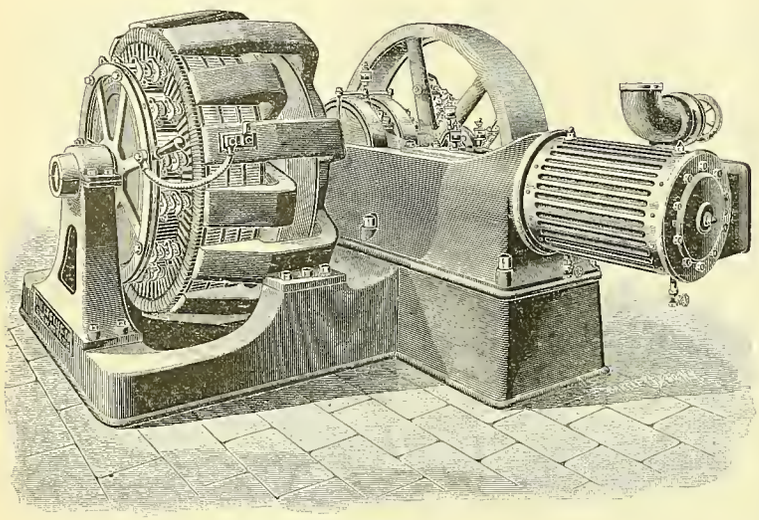
## MULTIPOLAR DYNAMOS, BIPOLAR DYNAMOS.

DIRECT DRIVEN OR BELTED IN SIZES UP TO 250 H. P. UP TO 100 H. P.



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***Complete Plants for Power Transmission.***

***Isolated Lighting Plants.***

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***Electric Motors,*** (*Automatic or Hand Controlled.*)

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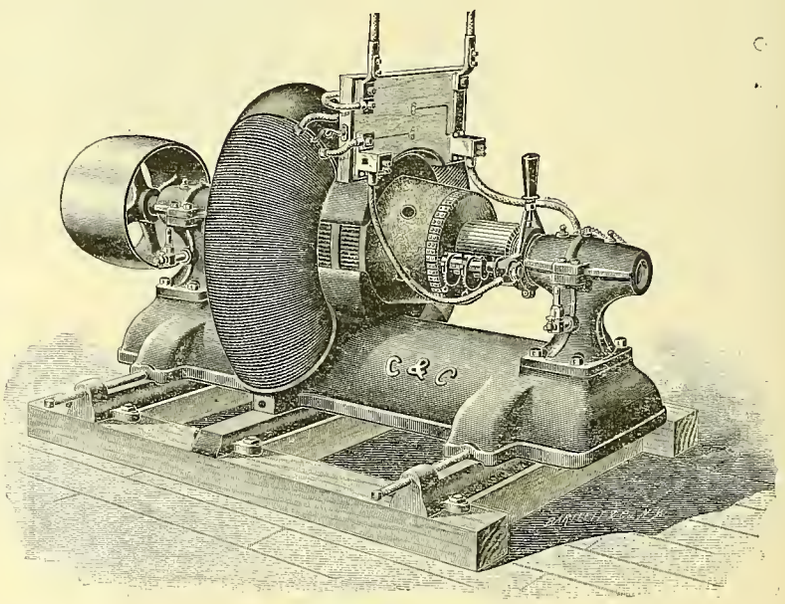
Extreme slow speed for direct connection to engines.



TYPE "D."

## Read Illustrated Article, Page 267.

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# TRIED, TESTED, PROVEN THE BEST

AT

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READ ARTICLE On Page 267

*And you will see that you make no mistake in selecting*

**OKONITE.**

READ ARTICLE On Page 267

*They wanted*

**THE BEST**

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Electric Light, Railway, Telephone and Telegraph Companies always **make a hit** by using Okonite.

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Up to 100 H. P.

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Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

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# "SIX 16 C. P., 75 VOLT LAMPS."

From our 50-volt, 5-light Dynamo.

Read the Following Unsolicited Testimonial—Then Send for Our Circular No. 44.

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GENTLEMEN:—The 5-light, 50-volt dynamo was received in good order and tested with the following results: The dynamo gave 75 volts and *easily lighted six lamps of 16 C. P.;* also an arc lamp of 3,500 C. P. As a motor it ran perfectly and without noise on a 75-volt circuit, starting on 1¾ volts and giving ¾ H. P. at 75 volts. In these experiments the armature and field coils did not heat, which is remarkable, as the machine was one of your regular 50-volt windings. The dynamo is all you claim for it and more, and I shall be pleased to give parties desiring it any information possible on receipt of stamp for postage. Hoping you will have an abundance of orders, which your work merits, I remain,

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Direct Connected Dynamos.

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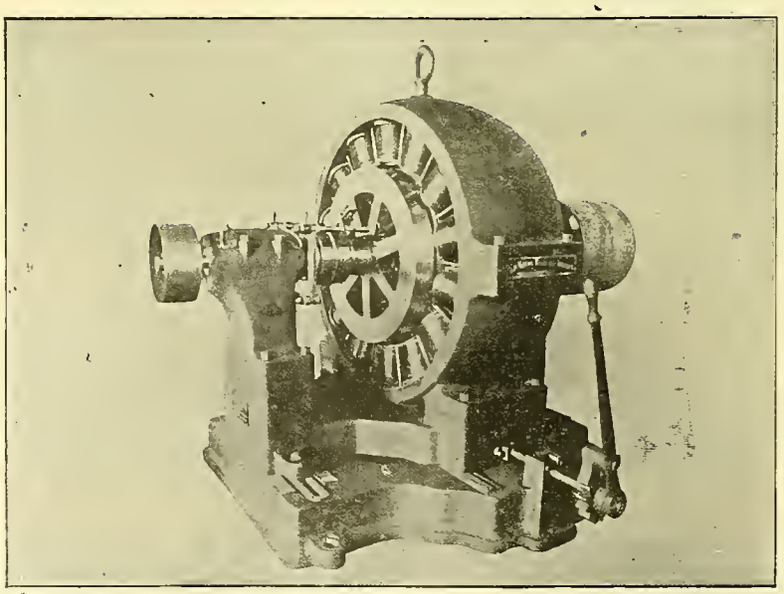

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## New Alternating Arc Lamp

### For Street Lighting

No. 13.
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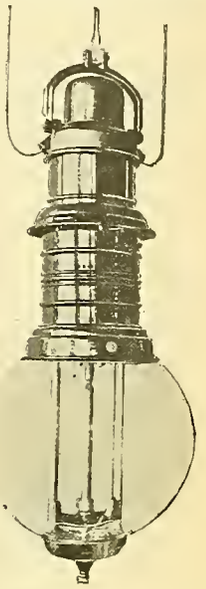
New Alternating Lamp 900 c. p, 7 amperes at 28 volts or 4½ amperes at 50 volts, 2¼ amperes at 100 volts. It consumes the energy of 3½ 16 c. p. incandescent lamps. A small alternating lamp is only possible with a reflector plate.

We have just completed a new direct current lamp which we guarantee will not **SEE-SAW.** The mechanism is entirely novel. By means of this arrangement the most troublesome feature in running lamps in series is eliminated.



No. 10.
Street Lamp, either 12 or 14 hour, to be used in connection with Special 33 Volt Transformer.

*Low Potential*
*Direct Current Lamps*

Write us for Prices and Discounts

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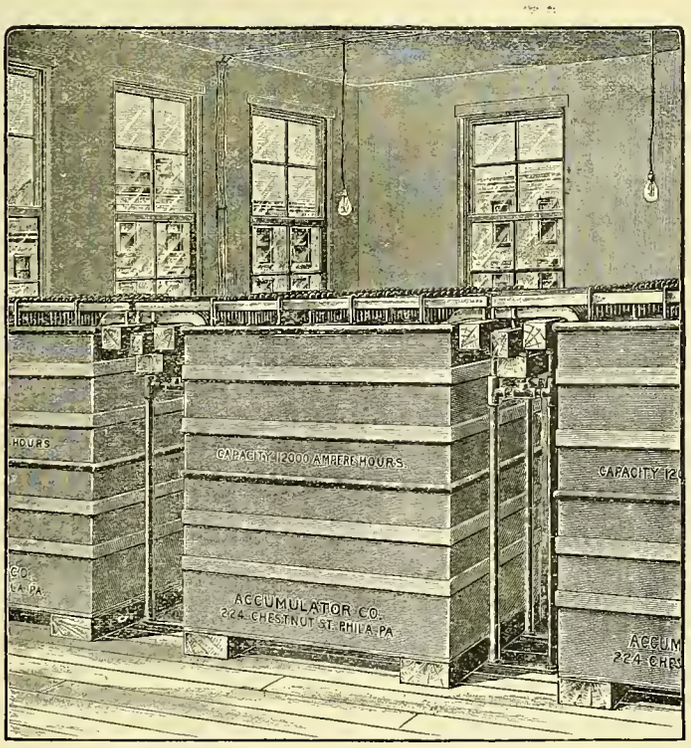
**Helios Electric Company** PHILADELPHIA, PA.

# Accumulator Company.

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New Type with Independent Plates which can be Easily Examined and Replaced without interfering with Charge or Discharge. Capacity from 350 to 12,000 Ampere Hours. No Nuts, Bolts or Screws. Meets all Requirements of Central Stations.

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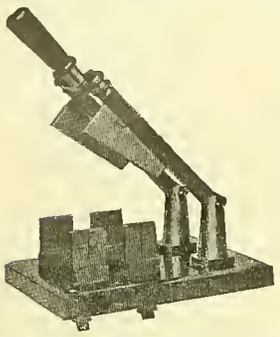
**Switches, Switch-Boards, Tablet-Boards.**



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For Arc Light and Trolley Cord.

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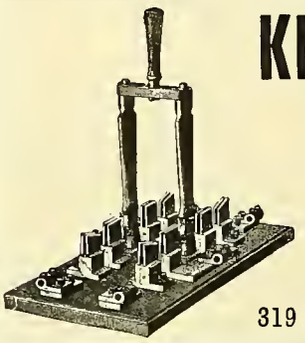

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Special Prices on 25 Amp. Switches.

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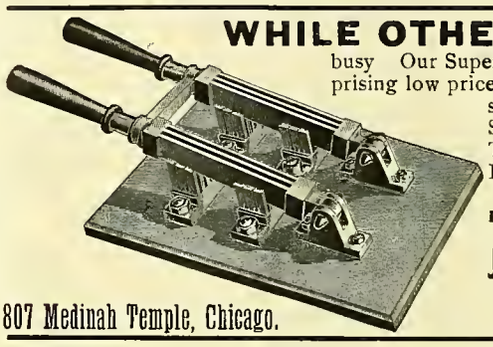

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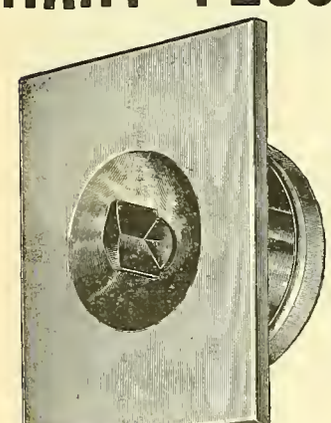

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**The Only Snap Switch that has PROVEN A SUCCESS.**

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**The Hart & Hegeman MANUFACTURING CO.,**
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**OUR ALTERNATOR HAS:**

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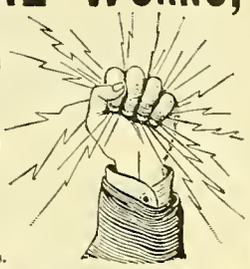
CABLES FOR AERIAL AND UNDERGROUND USE.



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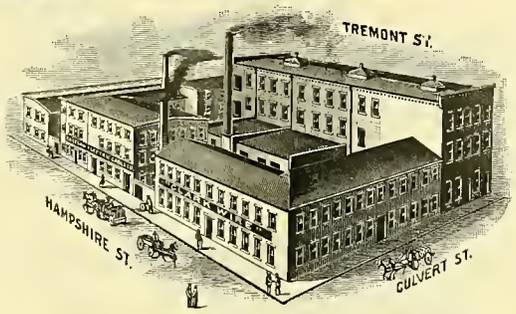


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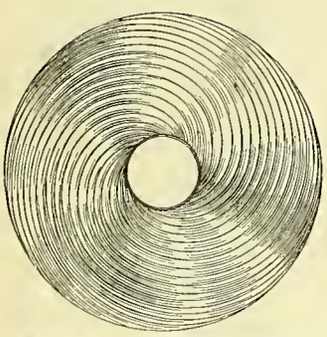

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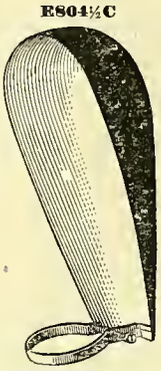

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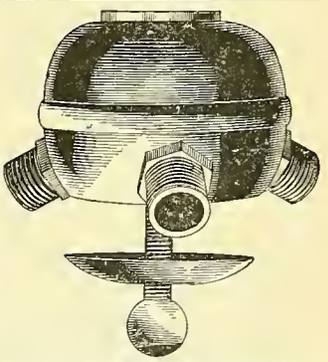

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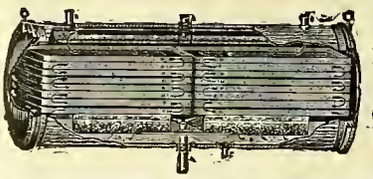

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One Westinghouse Alternator, 750 to 1,500 lights, complete with exciter and switchboard apparatus; 2,000 volts. Prefer No. 2 surface wound machine. Must be in first class condition. Write full particulars and price. Give width and diameter of pulley, and speed.

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A young man with fifteen years' experience as an electrical engineer desires a position as superintendent or electrician for street railroad or electric light company. Have had experience in all apparatus in practical use for light and power. Am also expert on steam. Can furnish references.

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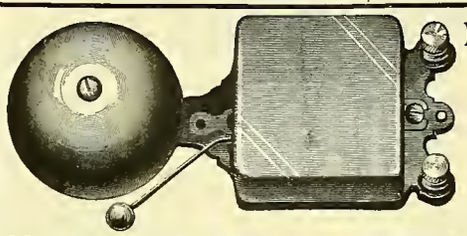

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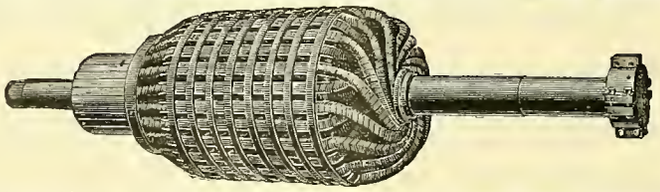

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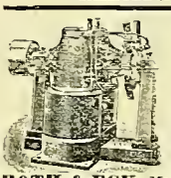

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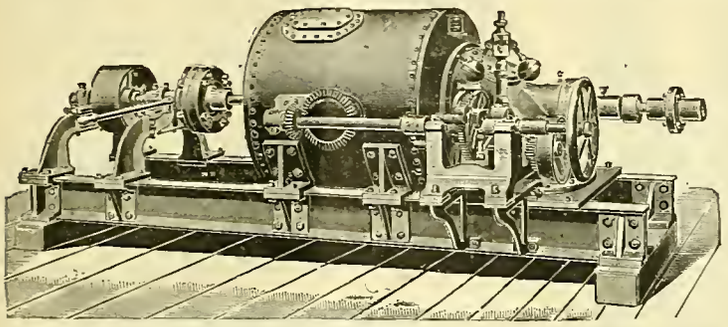

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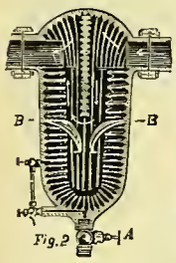


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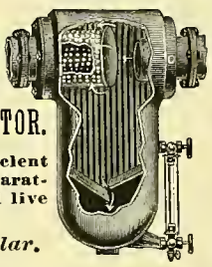

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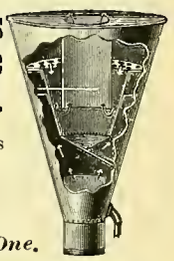

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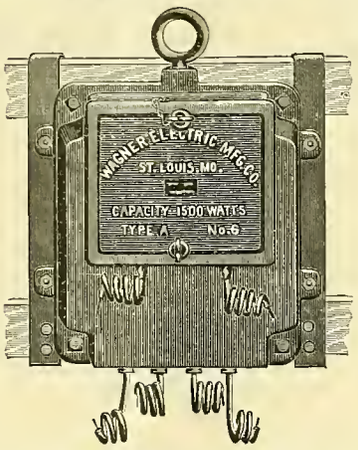


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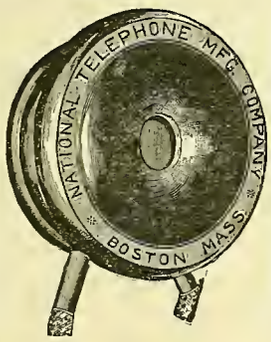


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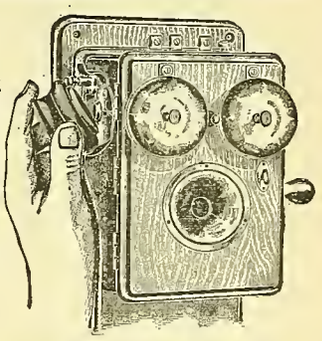

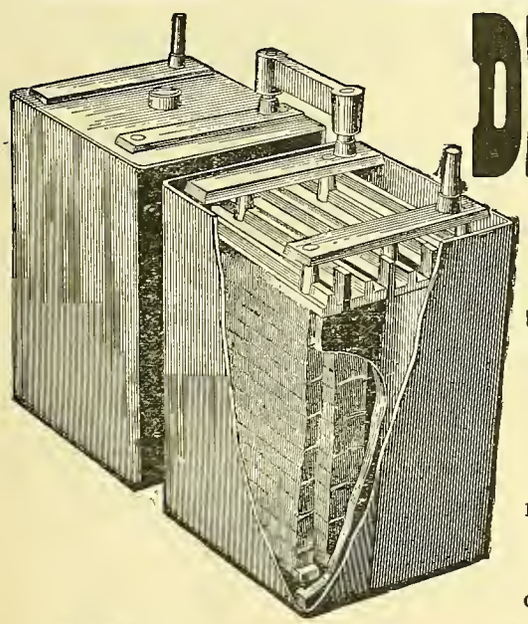

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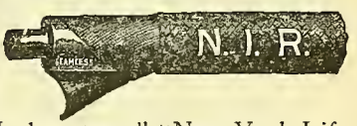


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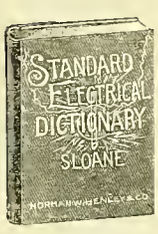


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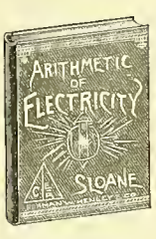


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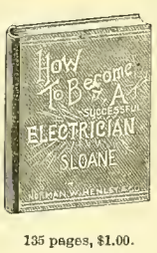


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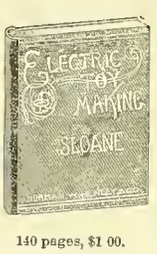


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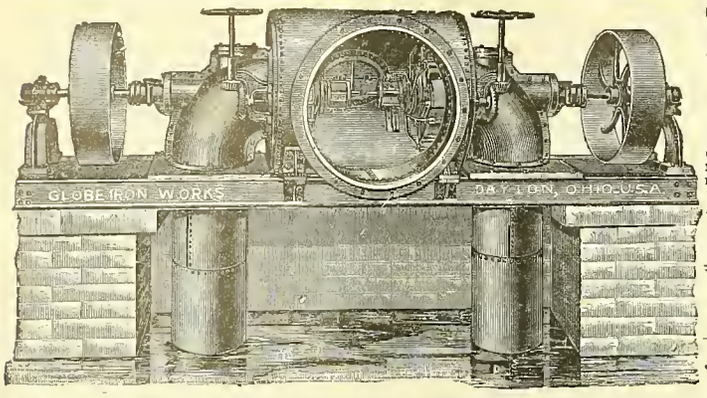


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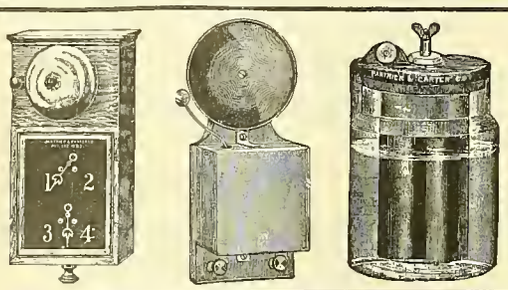

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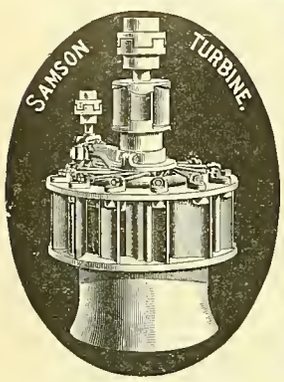


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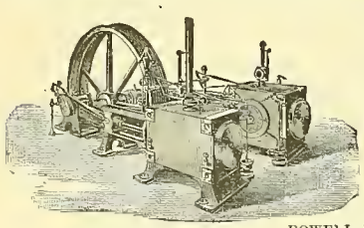

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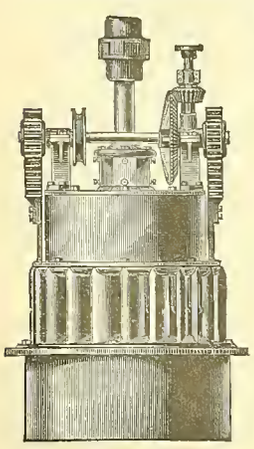

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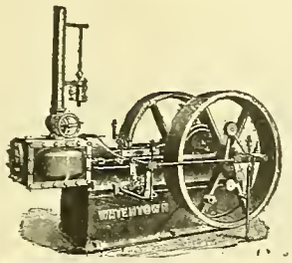

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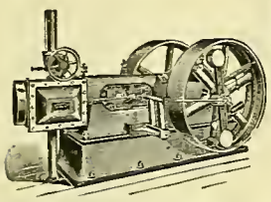

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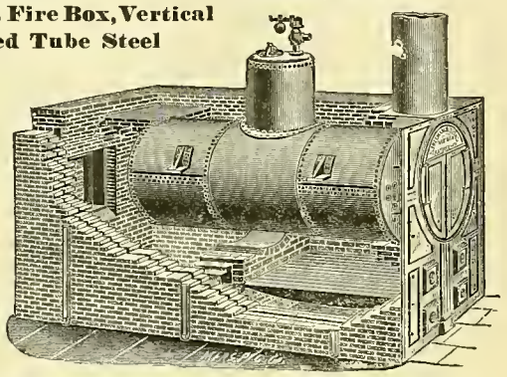

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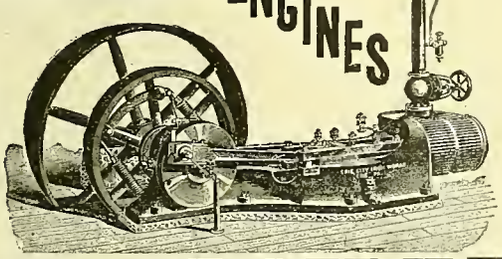

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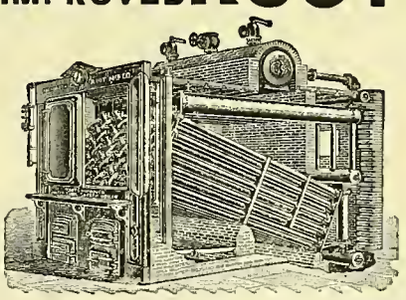

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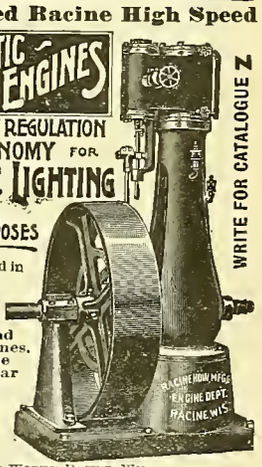

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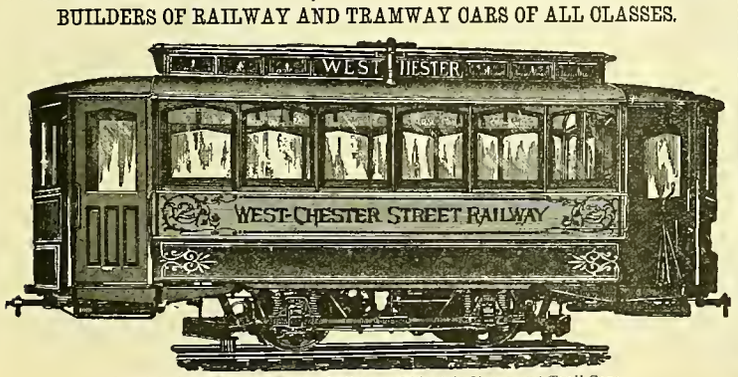


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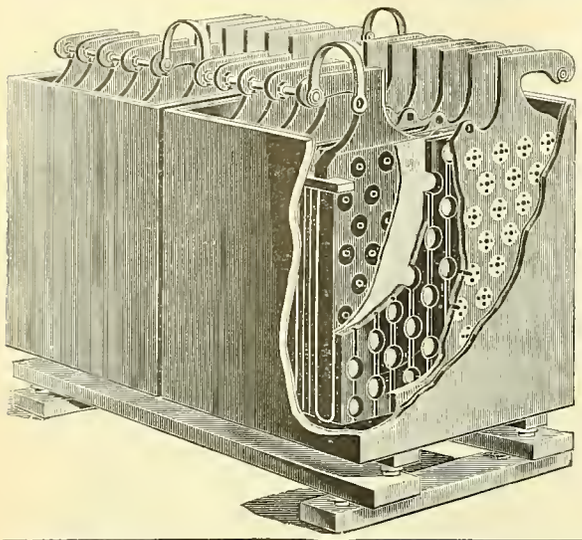

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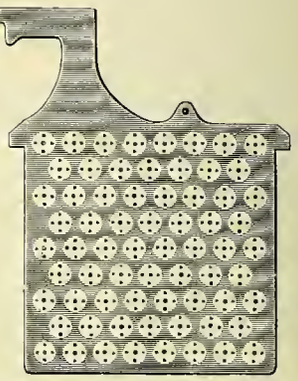

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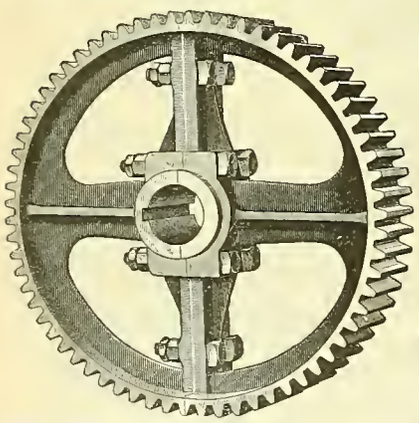

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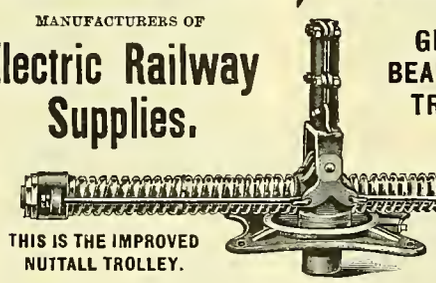

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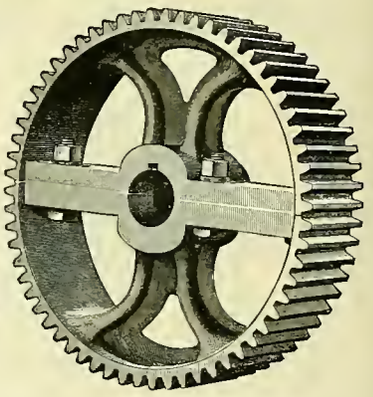

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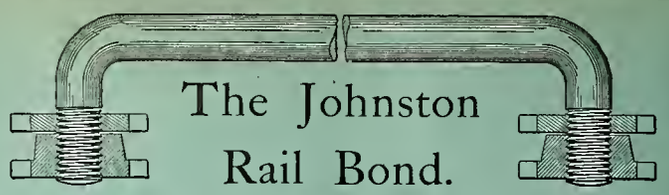

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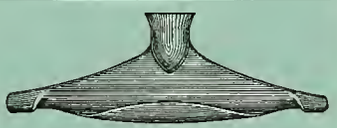

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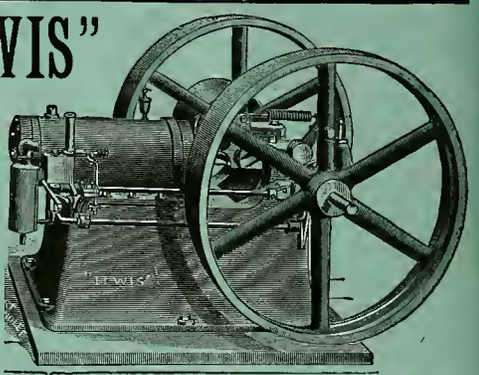

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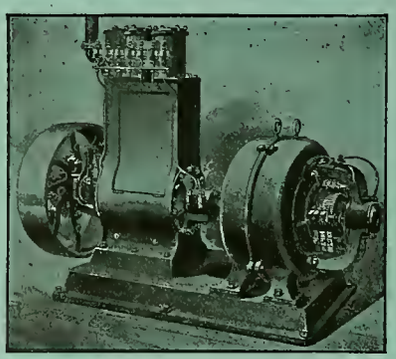

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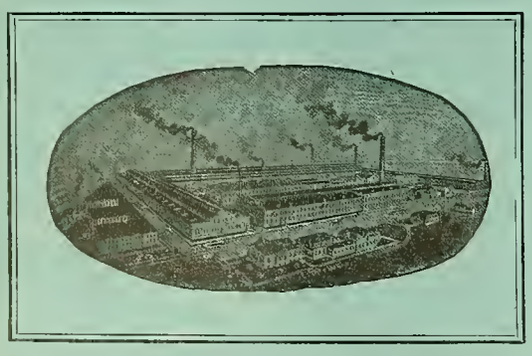

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Vol. XV. CHICAGO, DECEMBER 15, 1894. No. 24



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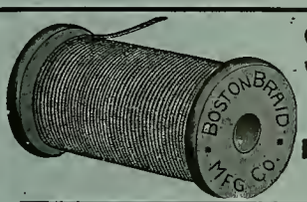


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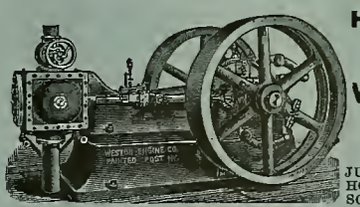

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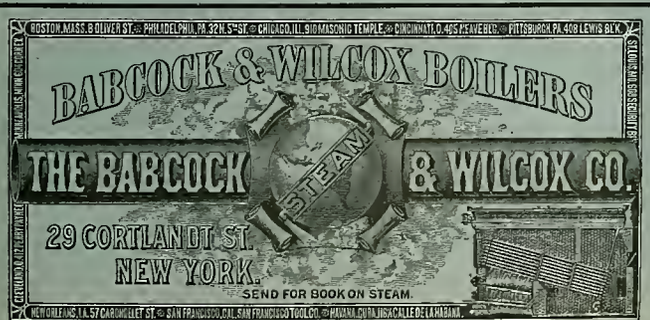


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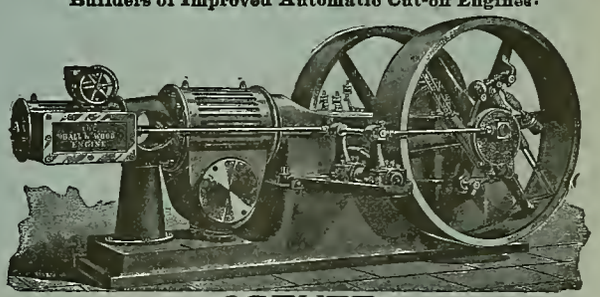

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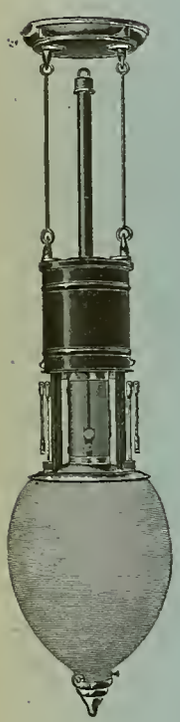

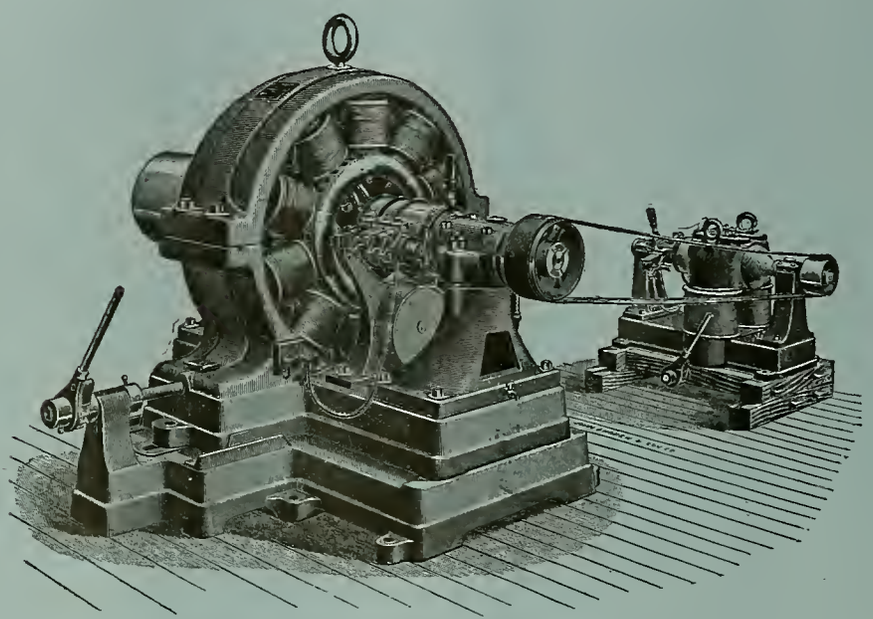

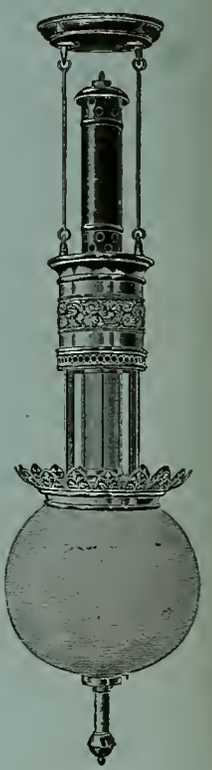

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**Accumulators.**
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Boswell & Co., D. E.,
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

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Dearborn Electric Co.
Electric Appliance Co.
Huebel & Manger.
Lee & Collins.
Metropolitan Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Washington Electric Co.
Western Elec. Supply Co.

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Auerbach-Woolverton El. Co.
C & C Electric Co.
Clark Electric Co.
Commercial Electric Co
Eddy Elec. Mfg. Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Inc'd'cent Arc Lt. Co.
Helios Electric Co., The.
Jennings, A. R.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Arc Light Cord.**
Samson Cordage Wks.

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Rushmore, S. W.

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Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Dearborn Electric Co.
Electric Appliance Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Hayden-Booker Mfg. Co.
Law Battery Co.
Leclanche Battery Co., The.
Lee & Collins.
Metropolitan Electric Co.
Miamisburg Electric Co.
Partrick & Carter Co.
Phœnix Carbon Mfg. Co.
Wallace Electric Co.
Western Electric Co.
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Dearborn Electric Co.
Electric Appliance Co.
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Ostrander & Co., W. R.
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Cushing & Morse.
Dearborn Electric Co.
Eastern Electric Cable Co.
Metropolitan Electric Co.
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New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons, Points & Plates.**
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Partridge Carbon Co.
Phœnix Carbon Mfg. Co.
Reisinger, Hugo.
Western Electric Co.

**Clocks, Electric.**
Self-Winding Clock Co.

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National Conduit Mfg. Co.

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Clark Electric Co.
Commercial Electric Co.
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Consolidated Engineering Co.
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Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
Mather Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
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Miamisburg Electric Co.

**Copper Wires.**
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Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Dearborn Electric Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Lee & Collins.
Metropolitan Elec. Co.
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**Cordage.**
Samson Cordage Wks.

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Electric Appliance Co.
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Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Cutter Electrical & Mfg. Co.
Dearborn Electric Co.
Diamond Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Interior Conduit & Ins. Co.
Jennings, A. R.
Large & Twining.
Lee & Collins.
Little, F. P. Elec. C. & S. Co.
Metropolitan Elec. Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg Co.
Commercial Electric Co.
Eddy Elec. Mfg. Co.
Elbridge Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Palmer Bros.
Roth & Eck.
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Rushmore, S. W.
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Western Electric Co.
Westinghouse Elec. & Mfg. Co.

**Economizers.**
Fuel Economizer Co.

**Electric Railways.**
Brush Electric Co.
General Electric Co.
Porter & Buerdorf.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Rushmore, S. W.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Dearborn Electric Co.
Diamond Electric Co.
Electric Appliance Co.
Interior Conduit & Ins. Co.
Large & Twining.
Lee & Collins.
Metropolitan Electric Co.
Nuttall Co., R. D.
Partrick & Carter Co
Sweet Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.
Lee & Collins.
Proctor-Raymond Elec. Co.

**Electrolirrs, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Gas.**
Webster Mfg. Co.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Partrick & Carter Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Jennings, A. R.
Lee & Collins.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.
Lee & Collins.
Partrick & Carter Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. Supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Commercial Electric Co.
Cutter Electrical & Mfg. Co.
Dearborn Electric Co.
Electric Appliance Co.
General Electric Co.
High & Co., J. Grant.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Lee & Collins.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Metropolitan Elec. Co.
Palmer Bros.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Jaeger Mfg. Co., The.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Induction Coils.**
Splitdorf, C. F.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Dearborn Electric Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Large & Twining.
Lee & Collins.
Little, F. P. Elec. C. & S. Co.
Metropolitan Elec. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Paragon Insulating Co.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Technic Electrical Wks.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Cushing & Morse.
Dearborn Electric Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Lee & Collins.
Metropolitan Elec. Co.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec. Co.
Bernstein Electric Co.
Buckeye Electric Co.
Dearborn Electric Co
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Jaeger Mfg. Co., The.
Metropolitan Electric Co.
New York & Ohio Co.
Partrick & Carter Co.
United Elec. Imp. Co.
Westinghouse Elec. & Mfg. Co.

**Lightning Arresters.**
Colgate Co., Geo. L.
Diamond Electric Co.
Electric Appliance Co.
General Electric Co.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery.**
Bliss Co., E. W.
Hine & Robertson Co.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Mather Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.

**Packing.**
Garlock Packing Co.

**Paints.**
Lee & Collins.
Paragon Insulating Co
Standard Paint Co.

**Patents.**
Gooch, Chas. J.

**Phosphor Bronze.**
Phosphor Bronze Sm. Co. Ltd

**Platinum.**
Baker & Co.

**Poles.**
Brownlee & Co.
Morris, Tasker & Co.
Nuttall Co., R. D.

**Porcelain.**
Empire China Works.
General Electric Co.
Jenningis, A. R.
Phœnix Glass Co.

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Electrician Publishing Co.

**Push Buttons.**
Electric Appliance Co.
Huebel & Manger.
Metropolitan Electric Co.
Partrick & Carter Co.

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Rushmore, S. W.

**Sal Ammoniac.**
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Diamond Electric Co.
Whitney Elec. Instrument Co.

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Wortbington, Henry R.

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Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
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Electric Storage Battery Co.
Haschke & Creelman.
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Cushing & Morse.
Electric Appliance Co.
Lee & Collins.
Metropolitan Electric Co.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

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**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Electric Appliance Co.
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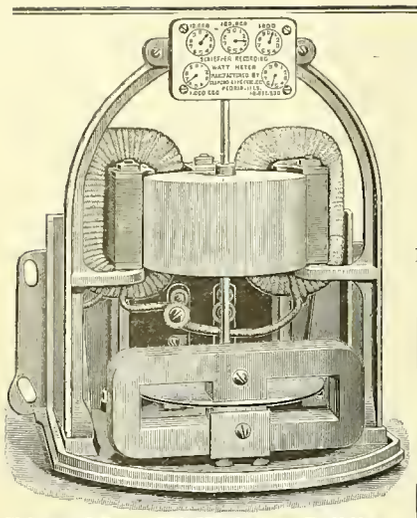
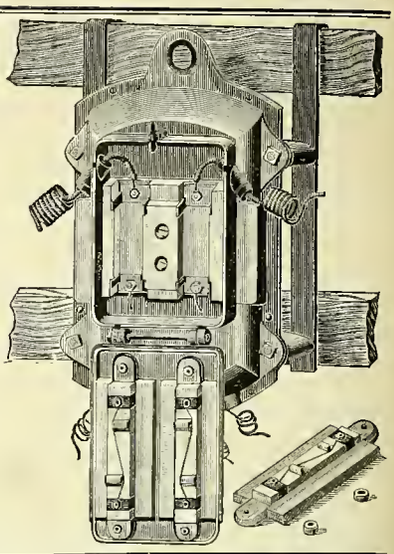


# SCHEEFFER'S RECORDING WATT-METER.

For Alternating Circuits. No Commutator. No Brushes.

Registers Direct Actual Power Consumed.

EASILY ADJUSTED. ABSOLUTELY RELIABLE.



# DIAMOND TRANSFORMER.

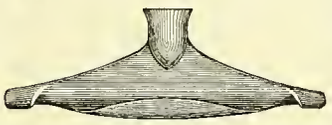
Simplest, Safest and Best.

FOR ANY VOLTAGE. FOR ALL SYSTEMS.

## DIAMOND ELECTRIC CO., Peoria, Ill.

Chicago Office, 1307 Manhattan Building, Central Electric Co., Selling Agents.

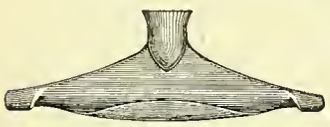
# "H. W. J." MECHANICAL CLIP.



An exceedingly simple and practical device consisting of a single casting—no parts to break or get out of order. Provides a straight underrun for and does not damage the trolley wheel. It holds the wire securely and is practically non-sparking. It is safe, economical and saves time.

Send for new and revised price list of

## Trolley Line Insulating Materials.



## H. W. JOHNS MFG. CO.,

240 AND 242 Randolph St.,

CHICAGO, ILL.

New York. Philadelphia. Boston.

# ARC LAMPS FOR INCANDESCENT CIRCUITS,

**Both Alternating and Direct.**

Standard "Ward" Lamps, - $10 Each.

TWO IN SERIES ON 110 VOLTS. Globe and Resistance, $2 extra per lamp.

A COMPLETE LINE of ENTIRELY NEW Arc Lamps.

SIMPLEST. STRONGEST. SUREST FEED.

Easiest and Cheapest to Maintain.

SPECIAL LAMPS OF ALL KINDS.

Write us for Circulars.

We carry a stock of FIDELITY carbons and IMPORTED CORED carbons, which we are selling at reduced prices.

Users of Arc Lamps should Write us for Prices.

## Electric Construction & Supply Co.,

18 Cortlandt Street, New York.

(Established 1881.)

Wallace Electric Co., Agents, 307 Dearborn Street, Chicago, Ill.

# C-S SPECIALTIES.

## C-S Flush Double Push Switch.

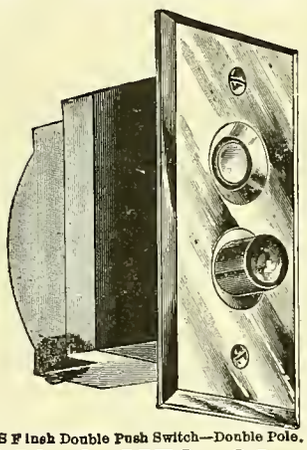
Single Pole—Double Pole—Commutation; 3 Wire, 4 Wire.

## C-S Flush Key Switch.

Single Pole—Double Pole—3 Wire.

## C-S Flush Automatic Switch.

Single Pole.



C-S Flush Double Push Switch—Double Pole.

ELECTRICALLY MECHANICALLY ARTISTICALLY **PEERLESS.**

## THE CUTTER ELECTRICAL & MFG. CO.,

*27 So. 11th Street, Philadelphia, Pa., U. S. A.*

# TELEPHONE WIRE AND CABLES.

Every Telephone Company in the United States is using Kerite Wire and Cables. Kerite is the Standard of High Grade Insulation, and will Cut Last and Out Class any other on the Market.

SEND FOR SAMPLES AND PRICES.

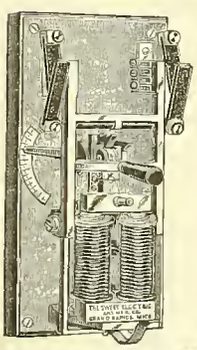
## CUSHING & MORSE,

General Western Agents,
225 Dearborn St., Chicago.

## W. R. BRIXEY, Mfr.

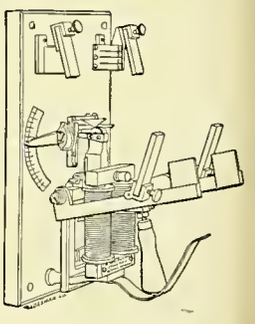
203 Broadway, New York.

# Hot Stuff.



No! we make the final break off from carbons so that it is impossible to get heat enough to fuse points of your copper contact plates; no filing off of rough points, no hanging on after you have had a short circuit or over load, bound to work as easily after opening 1,000 times as it does when opened the first time.

**WE KNOW YOU NEED OUR CIRCUIT BREAKER,** and do not see why you should delay writing us any longer. One burn out will pay for a dozen of our instruments. **To be used on the Alternating or Direct Current Systems.**



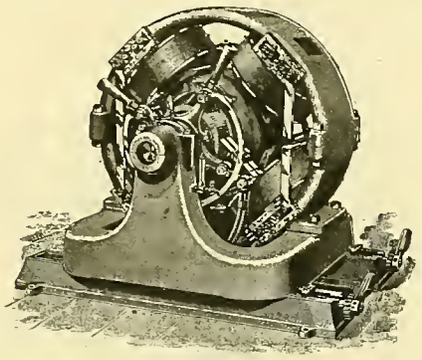
WRITE US AT ONCE.

# SWEET ELECTRIC & MFG. CO.,

GRAND RAPIDS, MICH.

# COMMERCIAL ELECTRIC CO.

*Belt Driven and*
*Direct Connected*
*Generators*
*For Street Railways,*
*Lighting and*
*Power Transmission.*



*Slow Speed.*
*Highest Efficiency.*
*Long Life Commutator.*
*Low Temperatures.*
*Perfect Regulation.*
*No Sparking.*

You want apparatus of the most

## PERFECT MECHANICAL AND ELECTRICAL CONSTRUCTION

To insure ***Long Life*** and ***Economy of Operation,*** and to avoid repairs. Write to us and we will tell you all about that kind of apparatus.

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## Commercial Electric Company,

115 South Capitol Avenue, - - - INDIANAPOLIS, IND.

# THE STANLEY

## Two-Phase System of Alternating Apparatus,

***The first and only complete and perfected system by which light and power can be supplied from the same generator. Power transmission and distribution made practical and commercially successful.***

In construction and operation the entire system is much more simple than any other, either direct or alternating.

The superior efficiency of the generator is in itself a handsome profit to any station.

It is practically self-regulating without the loss of energy involved by compounding or compensating.

The usual sources of trouble and expense in generators have been entirely eliminated from the Stanley; *i.e.* the revolving armature, commutators, collector rings, brushes, etc.

They can be built for any voltage from 110 for isolated lighting to 5,000 for power transmission work.

The motors excel in simplicity of construction; in starting torque and simplicity of starting device; in efficiency in the manner in which they take current in proportion to their load, and in the uniformity of speed under the different conditions of load.

Our transformers insure satisfactory service and the greatest economy. We are prepared to fill all orders promptly, and carry a full stock of transformers in Chicago.

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"No practical station man who has seen a Stanley alternator in operation will ever be satisfied with any other."

## STANLEY ELECTRIC MFG. CO., PITTSFIELD, MASS.

**Western Office, 307 Dearborn Street, Chicago, Ill.**

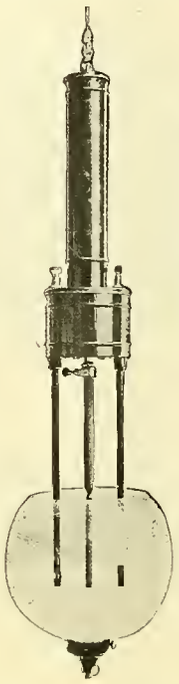
# THE HELIOS

## New Alternating Arc Lamp

### For Street Lighting

No. 13.
Inside 7 Ampere 7 Hour Lamp.

New Alternating Lamp 900 c. p, 7 amperes at 28 volts or 4½ amperes at 50 volts, 2¼ amperes at 100 volts. It consumes the energy of 3½ 16 c. p. incandescent lamps. A small alternating lamp is only possible with a reflector plate.



We have just completed a new direct current lamp which we guarantee will not SEE-SAW. The mechanism is entirely novel. By means of this arrangement the most troublesome feature in running lamps in series is eliminated.

No. 10.
Street Lamp, either 12 or 14 hour, to be used in connection with Special 33 Volt Transformer.

*Low Potential Direct Current Lamps*

Write us for Prices and Discounts

Eastern Agents: STANLEY ELECTRIC MFG. CO., Pittsfield, Mass.
Western Agents: CENTRAL ELECTRIC CO., Chicago, Ill.
Southwestern Agents: ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis, Mo.
New York City Agents: GLOBE ELECTRICAL SUPPLY & CONSTRUCTION CO., Vandam and Greenwich Streets.
MOUNTAIN ELECTRIC CO., Denver, Col., Agents for Colorado, Utah, Wyoming and New Mexico.
MACHINERY SUPPLY CO., Los Angeles, Cal., Agents for Lower California and Arizona.
Agents for Canada: CANADIAN GENERAL ELECTRIC CO., Ltd. Toronto, Canada.

**Helios Electric Company** PHILADELPHIA, PA.

# We Want Western Business.

## LA ROCHE ALTERNATORS.

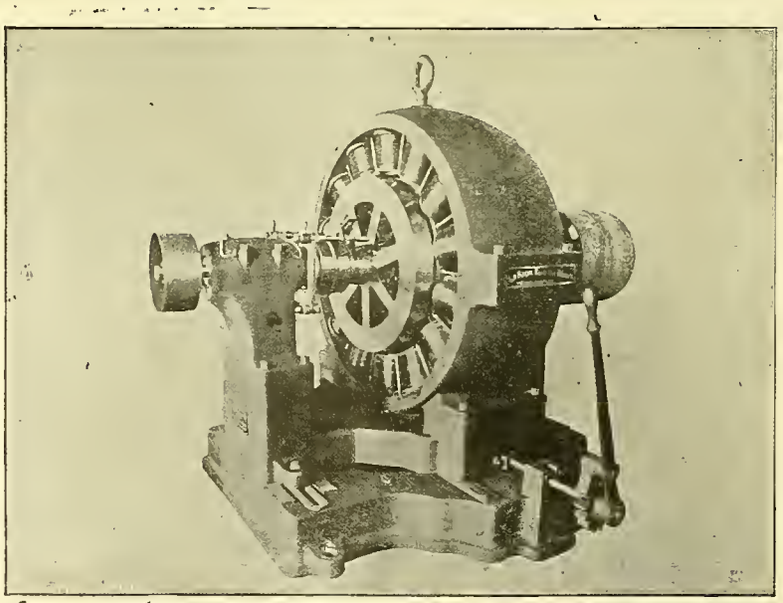
Manufactured in Sizes from

**25 to 5,000 Lights,**

**SINGLE**
OR
**MULTIPHASE.**

Direct Connected Dynamos.

Direct Current Generators.



**1,000 Light Alternator.**

**LA ROCHE ELECTRIC WORKS,**

PHILADELPHIA, PA.

DISTRICT OFFICES:

New York, Boston, Knoxville, Cincinnati, Pittsburg, San Francisco, Chicago. St. Louis, Mobile.

**WM. HOOD, 239 La Salle St., Chicago.** **OWEN FORD, Rialto Bldg., St. Louis, Mo.**

# Collins' Compound

Absolutely ACID PROOF,
WATER PROOF,
WEATHER PROOF.

Does not smell bad. DOES NOT COST MUCH.
Write for printed matter and quotations.

## FOR INSULATION
## Of Every Kind of Electrical Work.

An imperishable paint for preserving ***Metal***, ***Wood*** and ***Fabrics.***
Can be used on ***Armatures***, in place of shellac or other varnish, with perfect safety.
Invaluable for Mouldings, Cut out Boxes, and all Electrical work where insulating paint is specified or needed.
Will not peel off from metal or crack on wood.

FAVORITE **TAPE**

L. C. SPLICING COMPOUND.

## LEE & COLLINS,

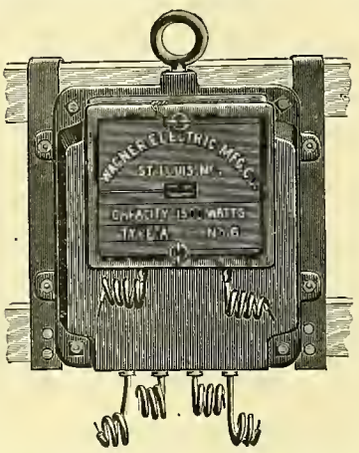
239 La Salle Street, CHICAGO.

We could do justice in this territory to one or two additional lines of first-class goods.
Correspondence with Eastern manufacturers desired.

MANUFACTURERS' AGENTS FOR
**HIGH CLASS ELECTRICAL SPECIALTIES.**

# ALTERNATING CURRENT TRANSFORMERS

Highest Efficiency Ever Obtained.




Standard Sizes, 5 Lights to 2,000 Lights.

## TRANSFORMERS

To order for any purpose, voltage or capacity.

## HIGH POTENTIAL SWITCHES,

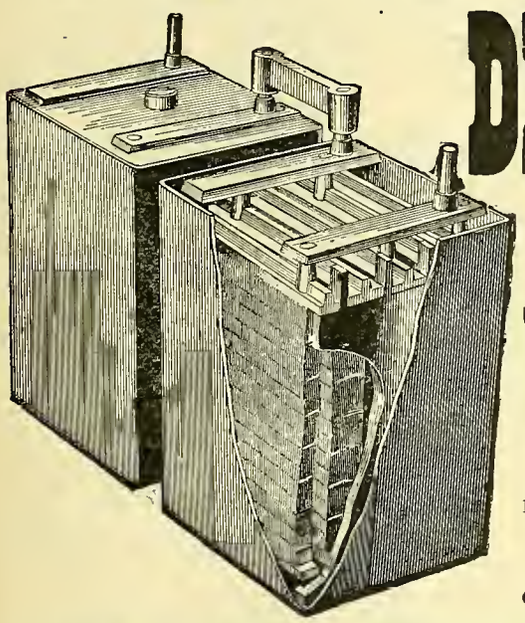
## ALTERNATING CURRENT MOTORS.

Complete Switch Boards

For Central Stations and Isolated Plants.

# WAGNER ELECTRIC MFG. CO., ST. LOUIS, MO.

BOSTON OFFICE, 15 Federal St. PHILADELPHIA OFFICE, John Mustard, 1000 Betz Building.



# DECISION IN OUR FAVOR

By all who have used

## STANDARD PLANTÉ BATTERIES.

Will not **Sulphate** nor **Disintegrate,** and cannot **Buckle.**

**HIGHEST EFFICIENCY, LARGEST DELIVERY, LEAST INTERNAL RESISTANCE.**

**Cells from 10 to 10,000 Ampere-Hour Capacity.**

## CENTRAL STATION INSTALLATIONS.

Batteries for **Electric Launches,** for **Dental, Surgical** and **Medical Work,** and for all purposes for which electricity is required.

**BATTERIES FOR TRACTION USE.**

Complete Lighting and Power Plants installed as reasonably as consistent with first-class material and workmanship.

## ELECTRIC-POWER STORAGE COMPANY, Room 1210, Havemeyer Building, 26 Cortlandt Street, NEW YORK.

# THE C & C ELECTRIC COMPANY

MANUFACTURERS OF

## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

General Office:
143 Liberty Street, NEW YORK.

Works: GARWOOD, N. J.
on CENTRAL R. R. of N. J.

BRANCH OFFICES: { CHICAGO, 1020 and 1021 Monadnock Building. BOSTON, 63 Oliver St.
CLEVELAND, Cuyahoga Building. PHILADELPHIA, 633 Arch St.

# The New "BERGMANN" Arc Lamps

For Constant Potential Circuits.

BETTER THAN ALL OTHERS BECAUSE

They have No Adjusting Springs and No Escapements and Consequently can Not Get Out of Adjustment or Flicker or Stick.

Send for Descriptive Circular of Direct and Alternating Current Lamps, Blade Switches, Imported Carbons, Etc. Prices greatly reduced on everything.

THE LATEST IS OUR NEW "TWIN" LAMP.

## GENERAL INCANDESCENT ARC LIGHT CO.,

NEW YORK.

169 Adams Street, CHICAGO. S. BERGMANN, President. 572 to 578 First Ave., NEW YORK.

MARO S. CHAPMAN, Pres. THOMAS C. PERKINS, Vice-Pres. JOHN L. BUNCE, Sec'y and Treas. TH. GONET, Supt.

# THE MATHER ELECTRIC COMPANY,

## Manchester, Conn.

## Power Generators for Lighting and Railway Purposes.

## Complete Station Equipments.

Mather Apparatus for sale exclusively in their respective territories by the following well-known and reliable Contractors:

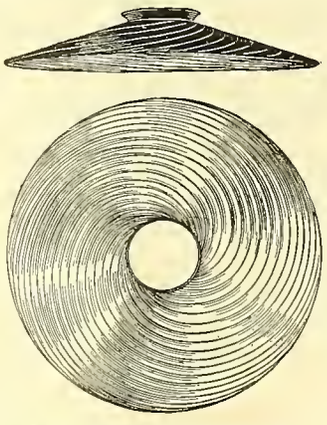
## J. HOLT GATES, 1140 Monadnock Building, Chicago, Western Contractor.

H. B. COHO & CO., 203 Broadway, New York: New York City, Brooklyn and vicinity and New Jersey.
G. M. ANGIER & CO., 64 Federal St., Boston, Mass: New England.
S. N. BLAKE, Elmira, New York: Northern and Western New York.
THE WILL & FINCK COMPANY, 818 Market St., San Francisco, Cal.: Agents for the Pacific Coast.

THEY ARE IN STOCK. SEND US A SAMPLE ORDER.

Radial Fluted.

| | | | PER DOZEN |
|---|---|---|---|
| 7 in. diameter, | 2¼ in. | holder, | $ 9.00 |
| 8 " " | 2¼ " | " | 10.00 |
| 9 " " | 2¼ " | " | 12.00 |



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| | | | PER DOZEN |
|---|---|---|---|
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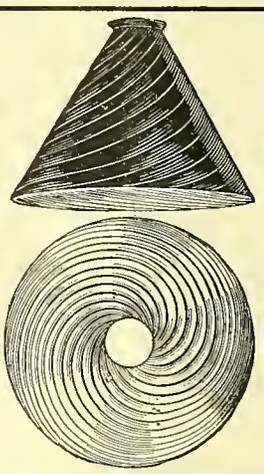

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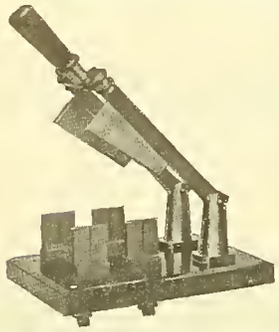

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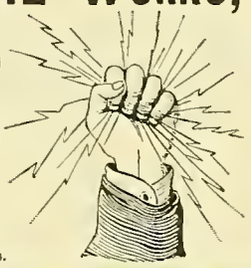

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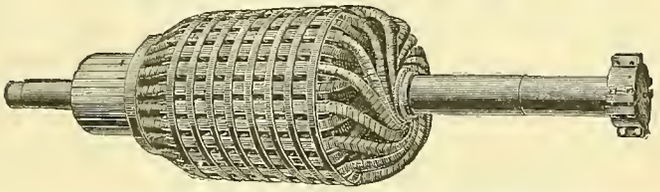

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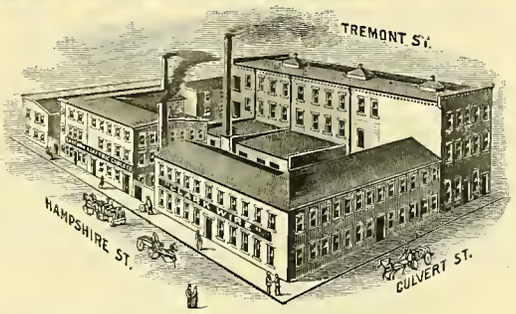


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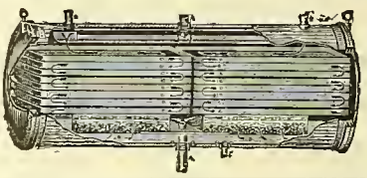

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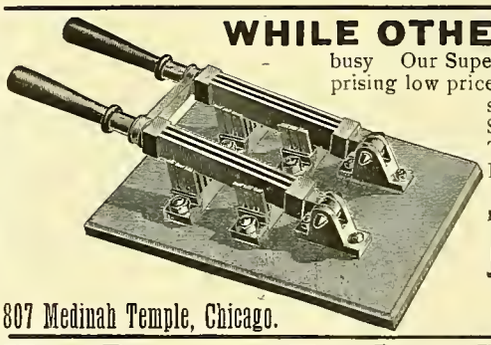

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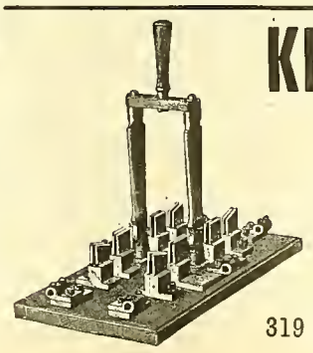

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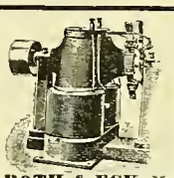

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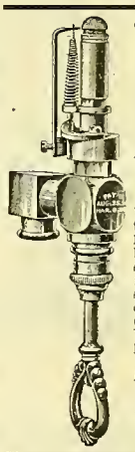

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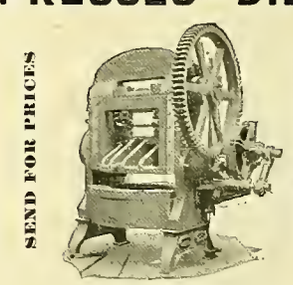


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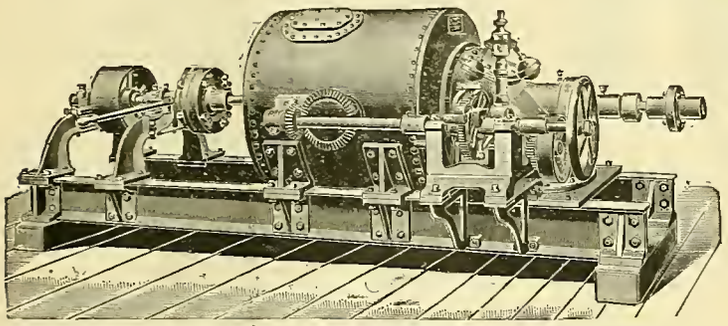

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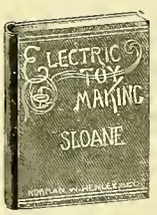


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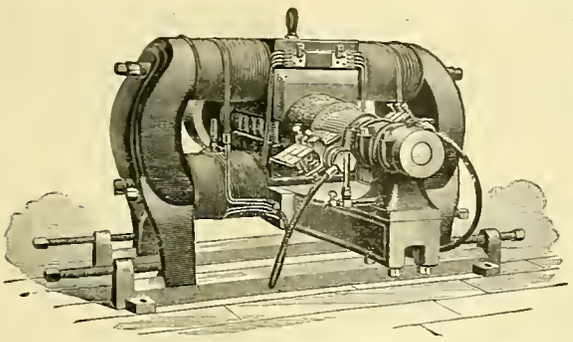

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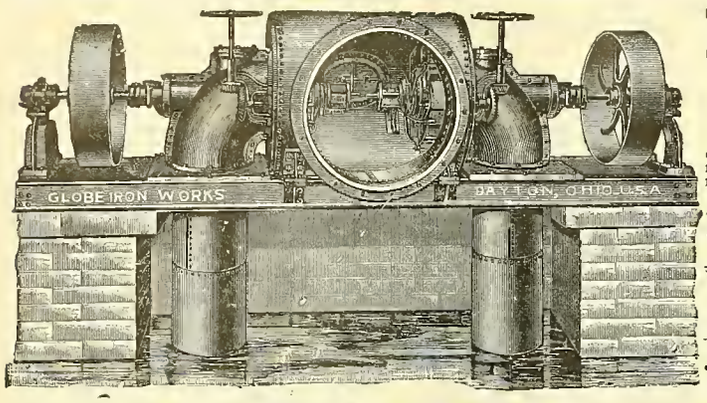


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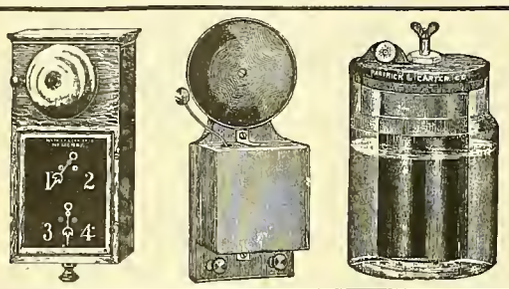


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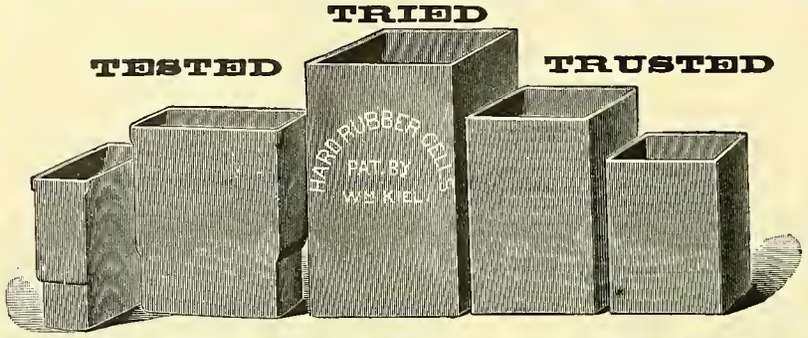


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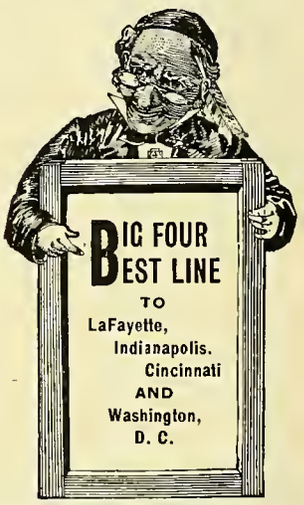

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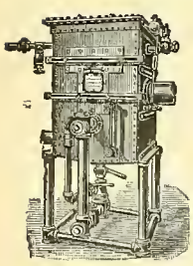

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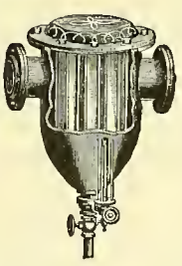

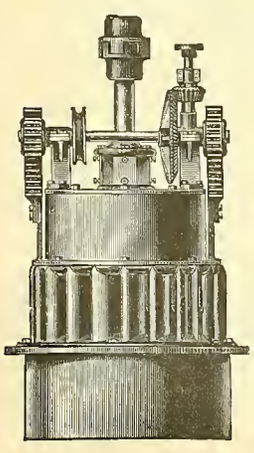

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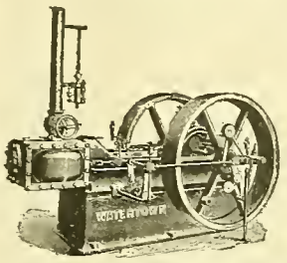

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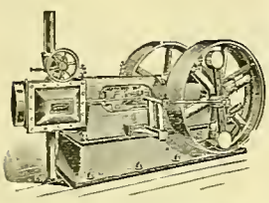

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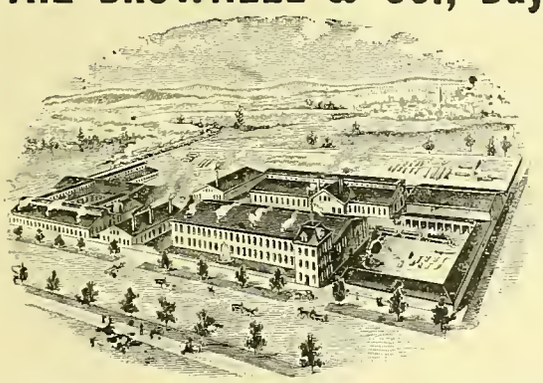

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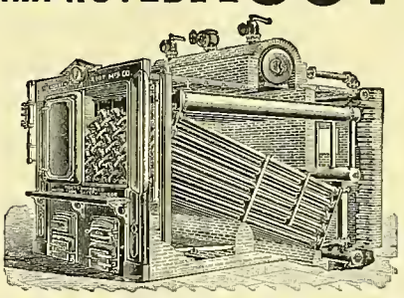

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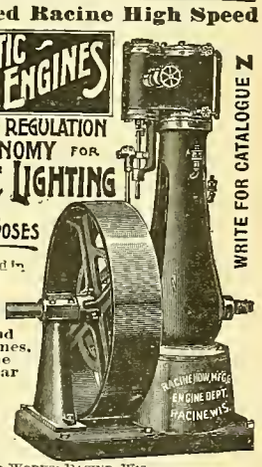

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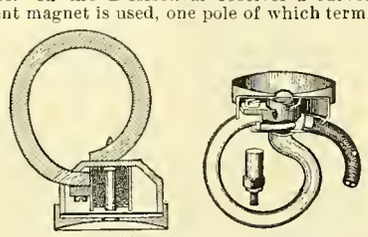
ductor. In the D'Arsonval receiver a curved permanent magnet is used, one pole of which terminates



FIGS. 27 AND 28. D'ARSONVAL RECEIVER.

in a soft iron polepiece that serves as the core of the coil, and the other in an iron box, or cylinder, that

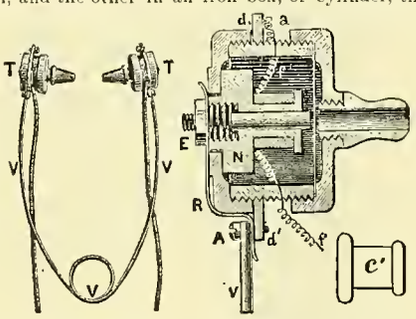



FIG. 29. MERCADIER'S BI-TELEPHONE. *T T* RECEIVERS, *V* SPRING, *N* MAGNET, *E* NUT, *R* STEEL STRIP, *A* SCREW CLAMPING *R* TO *V*, *d d'* METAL COLLAR CLAMPING *V* TO RECEIVER CASE, *f f* TERMINALS OF COIL *a* CONNECTING SCREW, *c'* SOFT RUBBER NIPPLE FOR EARPIECE.

completely encloses the coil. The two poles are magnetically insulated from each other by the wooden case, to the upper part of which the diaphragm is

48 TELEPHONE HAND BOOK.

appeared on the scene with an application for a patent on a microphonic transmitter, and according to the rules of the Patent Office no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbaugh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbaugh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad

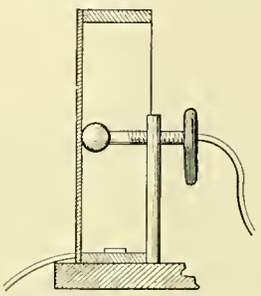


FIG. 44. BERLINER'S FIRST TRANSMITTER.

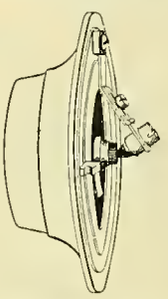


FIG. 45. BERLINER CARBON TRANSMITTER.

principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

78. Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by caus-

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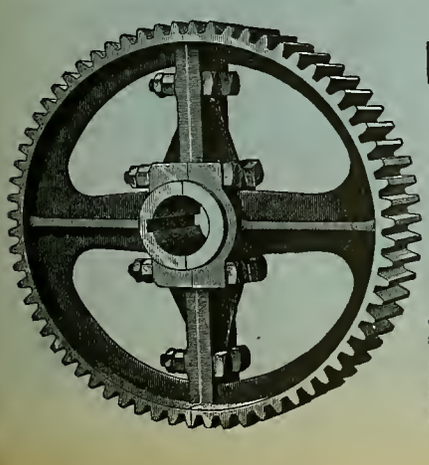

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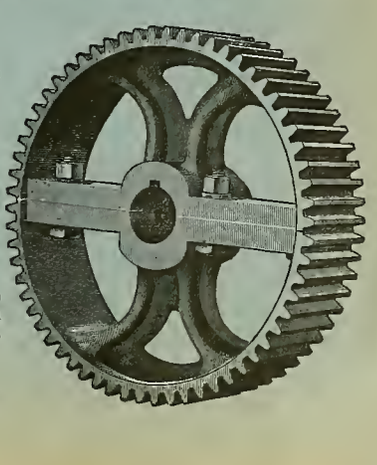

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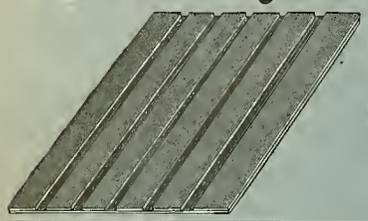

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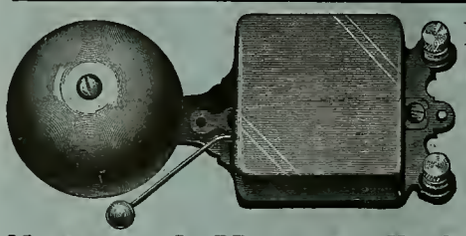

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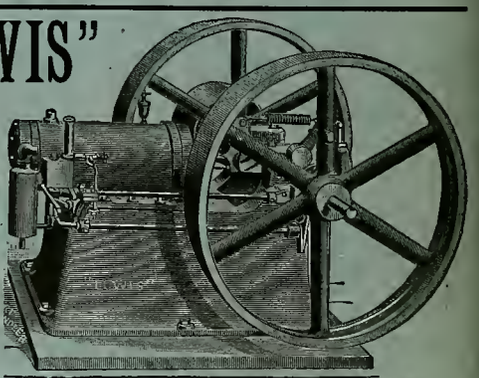

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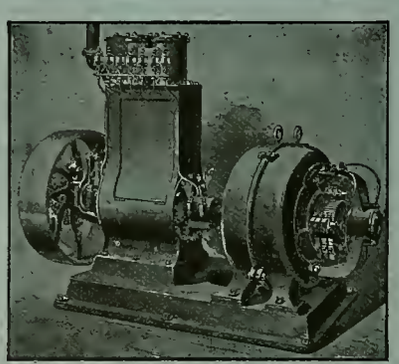

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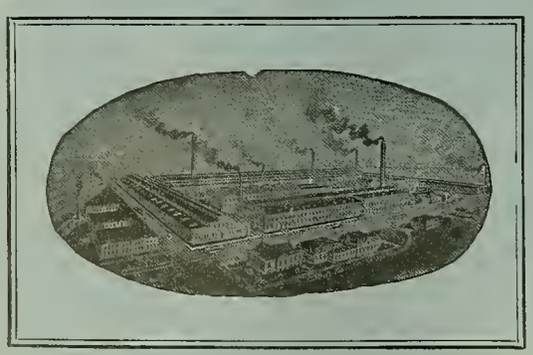

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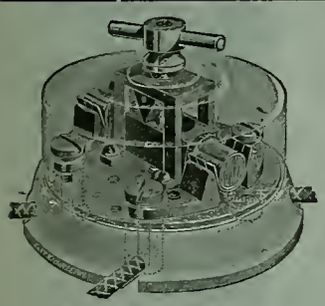

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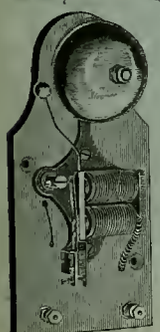

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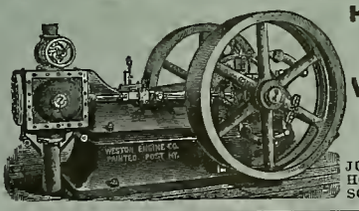

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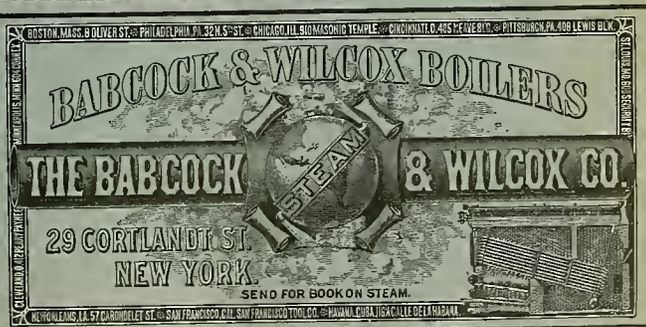


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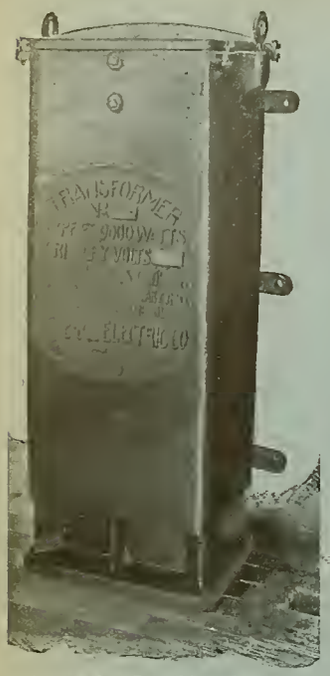

Largest Size Type F Transformer.

# TRANSFORMERS.

By the use of Transformers of our design and construction are obtained:

**Safety to Life and Property.**

**Efficiency** higher than in those of any other make.

**Regulation of Potential** perfect in its operation.

**Durability** attested by long experience.

**Convenience** in installation and maintenance.

**The Characteristics of our Type F Transformers are:**

**SIMPLICITY of CONSTRUCTION**—All accessories that can be sacrificed without impairing the value of the apparatus have been excluded from the box.

**PERFECTION OF INSULATION**—Obtained by the use of the highest grade insulating materials. As an additional protection, the core and coils are entirely immersed in oil, an extra safety factor only found in our Transformers.

**SUBDIVISION OF THE COILS**—Secondary winding the nearer to the iron core and the primary coils so subdivided that the greatest difference of potential between any two contiguous parts of the two windings brought down to only half the primary voltage.

**ABSENCE OF FUSES**—No dangerous opening of the Transformer to replace a blown fuse. Our Transformers may be installed in absolutely safe position almost inaccessible and the fuse box be easily accessible.

**SMALL CORE LOSS**—Only the most carefully tested iron used. Foucault currents eliminated and hysteresis reduced to a minimum.

**ABILITY TO WITHSTAND STRAIN**—All our Transformers are subjected to an efficiency test; a test under ordinary operating conditions, a test under 5,000 volts' pressure from coil to coil and coils to core, and a test exposing each turn to twice the strain of ordinary practice. All tests made without oil.

**COOLNESS OF OPERATION**—The oil acts as a cooling medium and adds to the efficiency as well as aiding the regulation in the Transformer.

## STEP UP and STEP DOWN TRANSFORMERS.

Write for our new Transformer pamphlet.

## SUB-STATION TRANSFORMERS.

200 K. W. Sub-Station Transformer, with Cool Air Blast.

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## CLASSIFIED LIST.


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Boswell & Co., D. E.,
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

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Electric Appliance Co.
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Partrick & Carter Co.
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Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

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Rushmore, S. W.

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Law Battery Co.
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Western Electric Co.
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Cushing & Morse.
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Partridge Carbon Co.
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Washington Carbon Co.
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Mather Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

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Miamisburg Electric Co.

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Bunnell & Co., J. H.
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Dearborn Electric Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Lee & Collins.
National India Rubber Co.
Okonite Co. The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

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Samson Cordage Wks.

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Brownlee & Co.
Electric Appliance Co.
Nuttall Co., R. D.
Partrick & Carter Co.

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Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
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General Electric Co.
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Colgate Co., Geo. L.
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Washington Electric Co.
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**Electrical Specialties.**
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Brownell & Co., The.
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McEwen Mfg. Co., J. H.
Racine Hardware Co.
Stoux City Eng & Iron Wks.
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Partrick & Carter Co.
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Roebling's Sons Co., J. A.
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Standard Paint Co.
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General Electric Co.
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Partrick & Carter Co.
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Colgate Co., Geo. L.
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General Electric Co.

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Munsell & Co., Eugene.

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Eddy Elec. Mfg. Co.
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La Roche Electric Wks.
Mather Electric Co.
Palmer Bros.
Royal Electric Co.
Roth & Eck.
Rushmore, S. W.
Sioux City Brass Works
Stanley Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co

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Garlock Packing Co.

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Paragon Insulating Co
Standard Paint Co.

**Patents.**
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Beethoven Piano & Organ Co.

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Baker & Co.

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Jennings, A. R.
Phœnix Glass Co.

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Huebel & Manger.
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Rushmore, S. W.

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Worthington, Henry R.

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Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

**Street Cars.**
Brill, J. G. Co.

**Tapes, Insulating.**
American Electrical Works.
Cushing & Morse.
Electric Appliance Co.
Lee & Collins.
Moore, Alfred F.
New York Insulated Wire Co
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

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Electric Appliance Co.
Partrick & Carter Co.
Western Electric Co.

**Telephones**
National Telep. Mfg. Co.
Palmer Bros.
Partrick & Carter Co.
Western Electric Co.
Western Tel. Const. Co.

**Telephone Books.**
Bradley & Co.

**Transformers.**
Diamond Electric Co.
General Electric Co.
Hornberger Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Jennings, A. R.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Trolley Cord.**
Samson Cordage Wks.

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General Electric Co.
Westinghouse El. & Mfg. Co.

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Dayton Globe Iron Works Co.
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Phillips Insulated Wire Co
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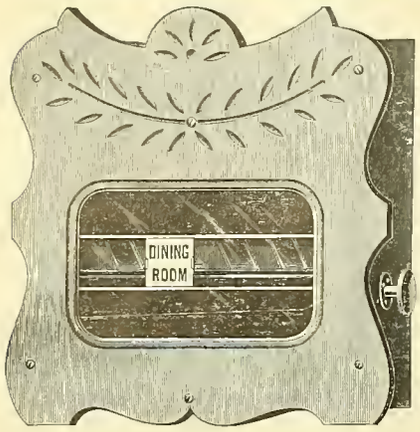
Our Motto: The Very Best Goods at the Very Lowest Prices.




# Eclipse Annunciator

The simplest and most reliable Annunciator made.
Not a spring or screw in the working parts.
Absolutely nothing to get out of adjustment, and
It requires but very small battery power

**Proctor-Raymond Electric Co.**
ROCHESTER, N. Y.

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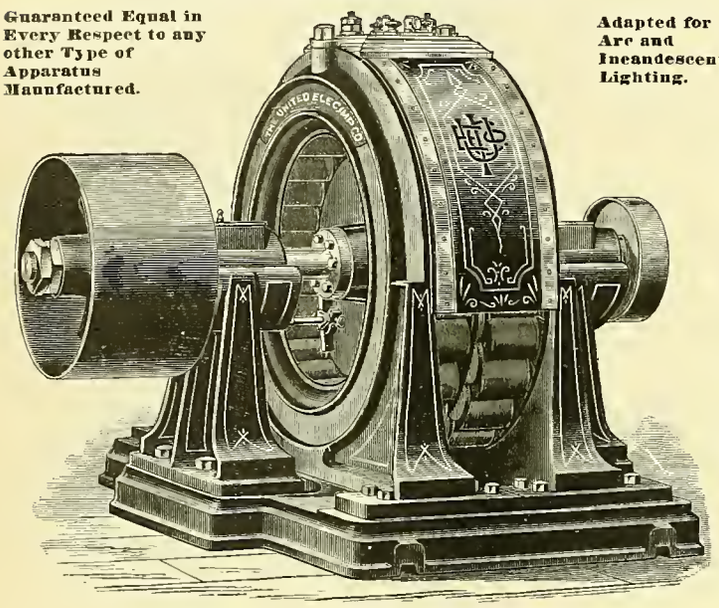
**SINGLE OR MULTIPHASE,**

## Alternating Current Generators,

**For Central Station Equipment.**

**Guaranteed Equal in Every Respect to any other Type of Apparatus Manufactured.**

**Adapted for Arc and Incandescent Lighting.**



Slow Speed and Close Regulation.

Standard of Simplicity and Durability.

**ALSO**

Direct Current Apparatus for Lighting Factories, Public Buildings and Isolated Plants.

Improved Long Distance Series Incandescent Apparatus for Street and Commercial Illumination.

Incandescent Lamps and Sockets for use on Arc Light Circuits.

**Correspondence Solicited.**

**THE UNITED ELECTRIC IMPROVEMENT CO.,**
19th St. and Alleghany Ave., Philadelphia, Pa.

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## ARC LAMPS FOR INCANDESCENT CIRCUITS,

**Both Alternating and Direct.**

Standard "Ward" Lamps, - $10 Each

TWO IN SERIES ON 110 VOLTS. Globe and Resistance, $2 extra per lamp.

**A COMPLETE LINE of ENTIRELY NEW Arc Lamps.**

**SIMPLEST. STRONGEST. SUREST FEED.**

Easiest and Cheapest to Maintain.

SPECIAL LAMPS OF ALL KINDS.

**Write us for Circulars.**

We carry a stock of FIDELITY carbons and IMPORTED CORED carbons, which we are selling at reduced prices.

**Users of Arc Lamps should Write us for Prices.**

**Electric Construction & Supply Co.,**
18 Cortlandt Street, New York.
(Established 1881.)

**Wallace Electric Co., Agents, 307 Dearborn Street, Chicago, Ill.**

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## "H. W. J." MECHANICAL CLIP.

An exceedingly simple and practical device consisting of a single casting—no parts to break or get out of order. Provides a straight underrun for and does not damage the trolley wheel. It holds the wire securely and is practically non-sparking. It is safe, economical and saves time.

Send for new and revised price list of

Trolley Line Insulating Materials.

**H. W. JOHNS MFG. CO.,**

240 and 242 Randolph St.,
CHICAGO, ILL.
New York. Philadelphia. Boston.

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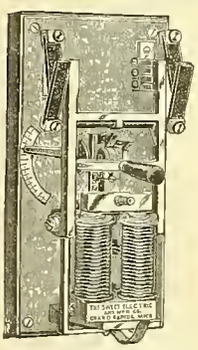
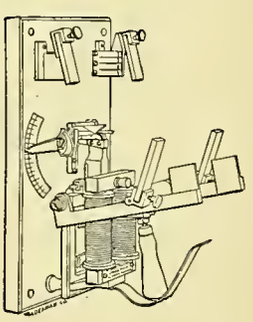
# Hot Stuff.



No! we make the final break off from carbons so that it is impossible to get heat enough to fuse points of your copper contact plates; no filing off of rough points, no hanging on after you have had a short circuit or over load, bound to work as easily after opening 1,000 times as it does when opened the first time.

**WE KNOW YOU NEED OUR CIRCUIT BREAKER,** and do not see why you should delay writing us any longer. One burn out will pay for a dozen of our instruments. **To be used on the Alternating or Direct Current Systems.**



**WRITE US AT ONCE.**

**SWEET ELECTRIC & MFG. CO.,**
GRAND RAPIDS, MICH.

# HELIOS CORED CARBONS.

FOR

# Alternating and Direct Currents.

Attempts have been made in this country to produce a satisfactory cored carbon, but failure resulted in every case. We can now assure the Electric Light Companies that our "HELIOS" CARBON is made of the same ingredients, in precisely the same way,

## By the man who made them in Germany.

We shall be glad to hear from the Electric Light interests of the country in relation to carbons for both Alternating and Direct Currents.

A memorandum book, with tables showing the relation between millimeters and inches, with a list of ordinary sizes of "HELIOS" CARBONS of our manufacture, will be sent on application.

## Reduced Prices on Solid Carbons for Series Arc Lighting.

# A DEPARTURE IN BUSINESS METHODS!

NOTE THIS OFFER:---Let us know by telegraph the price you are now paying, stating yearly consumption, and we will guarantee to beat it from 50 cents to $2.00 per thousand. This is no "bluff" but is "dead cold" business.

# THE WASHINGTON CARBON COMPANY,

PITTSBURG, PA.

THE

# Chloride Accumulator.

The Electric Storage Battery Company has acquired all the patents and patent rights concerning the manufacture of electric storage batteries of the General Electric Company, the Edison Electric Light Company, the Thomson-Houston Electric Company, the Brush Electric Company, The Accumulator Company, The Consolidated Electric Storage Company and the General Electric Launch Company, whereby The Electric Storage Battery Company has secured to itself the sole right to supply in the United States electric storage batteries of all the various important types heretofore developed, as well as the protection of every decision heretofore rendered by the United States courts in the interpretation of electric storage battery patents.

The acquisition of these patents not only terminates all litigation heretofore existing, but insures the company against any future attacks, as the patents acquired, together with those originally owned by The Electric Storage Battery Company, cover all the known principles involved in storage batteries.

The Company has also increased largely its cash working capital, and is fully prepared to fill all orders for storage batteries promptly.

Catalogue containing full description of the various types of elements, weights, capacities, dimensions, etc., and price list, furnished on application.

## THE ELECTRIC STORAGE BATTERY CO.,

838 DREXEL BUILDING, PHILADELPHIA.

ABSOLUTELY ACID-PROOF, WATER-PROOF, WEATHER-PROOF.

# COLLINS' COMPOUND

## FOR INSULATION OF EVERY KIND OF ELECTRICAL WORK.

Does not smell bad. Does not cost much.
Ask your supply dealer for it.
Insist on getting it.
Write us for printed matter and quotations.

An imperishable paint for preserving METAL, WOOD and FABRICS. Can be used on ARMATURES, in place of shellac or other varnish, with perfect safety. Invaluable for Mouldings, Cut-out Boxes, and all Electrical work where insulating paint is specified or needed. Will not peel off from metal or crack on wood.

## FAVORITE TAPE
## L.C. SPLICING COMPOUND.

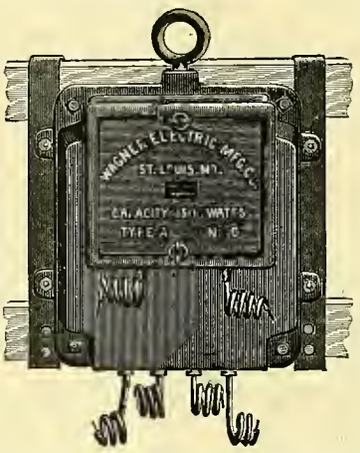
**LEE & COLLINS, 239 La Salle St., Chicago.**

Manufacturers' Agents for High Class Electrical Specialties.

We could do justice in this territory to one or two additional lines of first-class goods. Correspondence with Eastern manufacturers desired.

# ALTERNATING CURRENT TRANSFORMERS

Highest Efficiency Ever Obtained.




Standard Sizes, 5 Lights to 2,000 Lights.

## TRANSFORMERS

To order for any purpose, voltage or capacity.

## HIGH POTENTIAL SWITCHES,

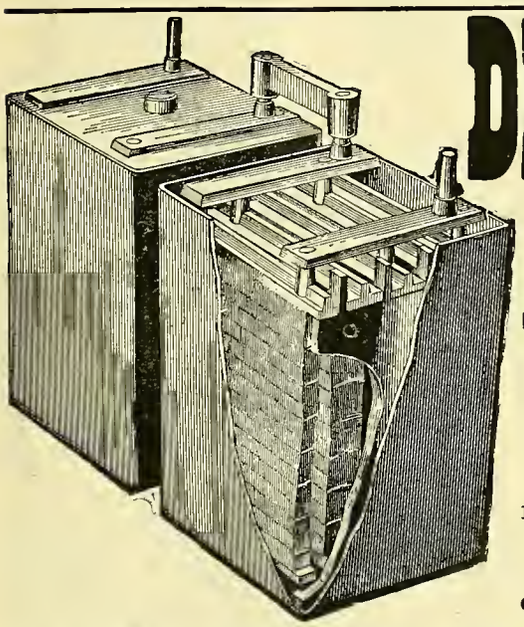
## ALTERNATING CURRENT MOTORS.

Complete Switch Boards

For Central Stations and Isolated Plants.

# WAGNER ELECTRIC MFG. CO., ST. LOUIS, MO.

BOSTON OFFICE, 15 Federal St. PHILADELPHIA OFFICE, John Mustard, 1000 Betz Building.



# DECISION IN OUR FAVOR

By all who have used

## STANDARD PLANTÉ BATTERIES.

Will not **Sulphate** nor **Disintegrate,** and cannot **Buckle.**

**HIGHEST EFFICIENCY, LARGEST DELIVERY, LEAST INTERNAL RESISTANCE.**

**Cells from 10 to 10,000 Ampere-Hour Capacity.**

## CENTRAL STATION INSTALLATIONS.

Batteries for **Electric Launches,** for **Dental, Surgical** and **Medical Work,** and for all purposes for which electricity is required.

## BATTERIES FOR TRACTION USE.

Complete Lighting and Power Plants installed as reasonably as consistent with first-class material and workmanship.

## ELECTRIC-POWER STORAGE COMPANY, Room 1210, Havemeyer Building, 26 Cortlandt Street, NEW YORK.

# THE C & C ELECTRIC COMPANY

MANUFACTURERS OF

## MULTIPOLAR DYNAMOS, BIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P. Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

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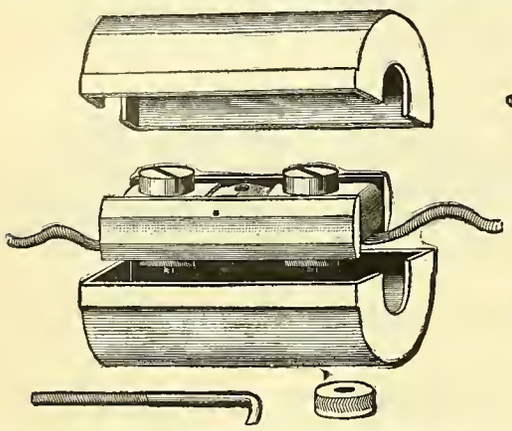
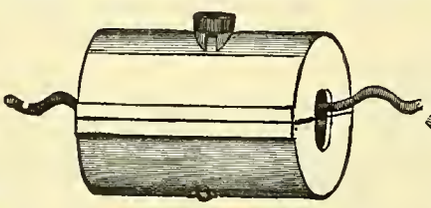
on CENTRAL R. R. of N. J.

BRANCH OFFICES: { CHICAGO, 1020 and 1021 Monadnock Building. BOSTON, 63 Oliver St.
{ CLEVELAND, Cuyahoga Building. PHILADELPHIA, 633 Arch St.

## GLEASON'S STANDARD FIXTURE CUT-OUTS, ETC., ETC.



Enlarged cut showing construction of Gleason's Porcelain Lighting-Bug Cut-Out covered with porcelain.



FULL SIZE CUT (When Closed)

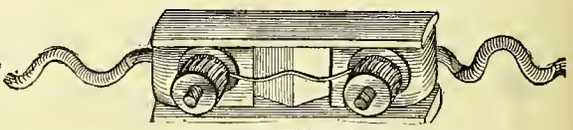
—OF—

Gleason's Porcelain Lighting-Bug Cut-Out,
with porcelain cover.

Smallest Covered Solid Porcelain Cut-Out on the Market.

*Price Each, Complete, 22½ cts. List.*

GLEASON'S LIGHTING-BUG CUT-OUT.



(Without Cover.)

PRICES SUBJECT TO REGULAR DISCOUNT.

*Price Each 10 cts., in Porcelain.*

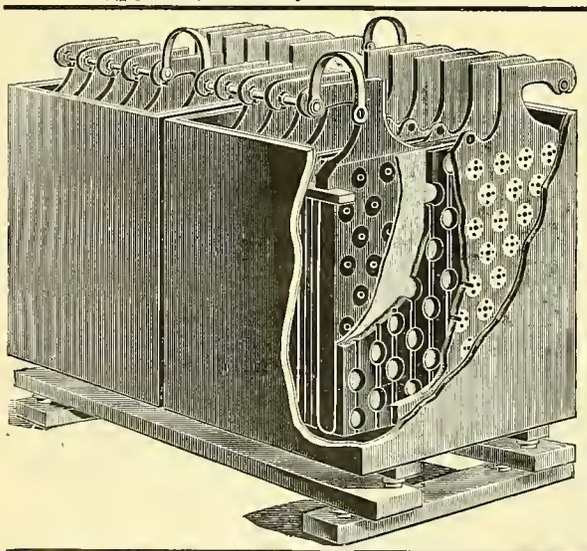
FIXTURE WIRE SEPARATE FROM FUSE WIRE WHILE ON SAME BINDING POST.

Best and Smallest Cut-Out Made.

E. P. GLEASON MFG. CO.,

CHICAGO OFFICE: 91 DEARBORN ST. F. L. JOHNSON, Manager.

181 to 189 Mercer St., COR. HOUSTON ST., NEW YORK CITY.



THE CHLORIDE ELECTRICAL STORAGE SYNDICATE, Limited, LONDON, ENGLAND.
SOCIETE ANONYME LE TRAVAIL ELECTRIQUE DES METAUX, PARIS, FRANCE.

**The Only Storage Battery in Use in Central Stations, of American Manufacture.**

## The Electric Storage Battery Co.,

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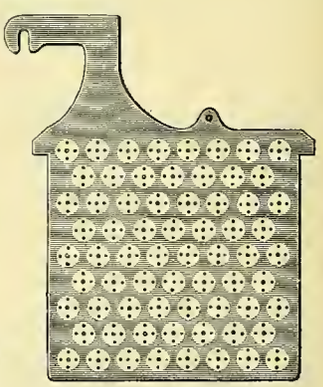
TRADE MARK.

# Chloride Accumulator.

Registered September 11, 1894.

Electrical Storage Cells of any desired capacity. Catalogues giving Capacities, Dimensions, Weights, Prices, etc., on application.



CHICAGO, Wabash Avenue and Lake Street.

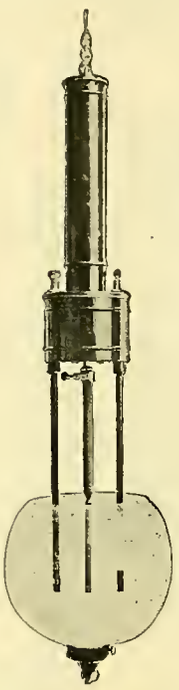
# THE HELIOS

No. 13.
Inside 7 Ampere 7 Hour Lamp.

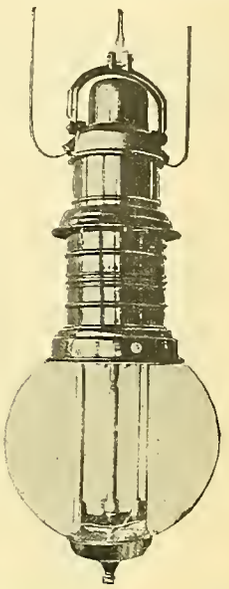
## New Alternating Arc Lamp

### For Street Lighting

New Alternating Lamp 900 c. p, 7 amperes at 28 volts or 4½ amperes at 50 volts, 2¼ amperes at 100 volts. It consumes the energy of 3½ 16 c. p. incandescent lamps. A small alternating lamp is only possible with a reflector plate.



We have just completed a new direct current lamp which we guarantee will not SEE-SAW. The mechanism is entirely novel. By means of this arrangement the most troublesome feature in running lamps in series is eliminated.



No. 10.
Street Lamp, either 12 or 14 hour, to be used in connection with Special 33 Volt Transformer.

*Low Potential Direct Current Lamps*

Write us for Prices and Discounts

Eastern Agents: STANLEY ELECTRIC MFG. CO., Pittsfield, Mass.
Western Agents: CENTRAL ELECTRIC CO., Chicago, Ill.
Southwestern Agents: ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis, Mo.
New York City Agents: GLOBE ELECTRICAL SUPPLY & CONSTRUCTION CO., Vandam and Greenwich Streets.
MOUNTAIN ELECTRIC CO., Denver, Col., Agents for Colorado, Utah, Wyoming and New Mexico.
MACHINERY SUPPLY CO., Los Angeles, Cal., Agents for Lower California and Arizona.
Agents for Canada: CANADIAN GENERAL ELECTRIC CO., Ltd. Toronto, Canada.

## Helios Electric Company

PHILADELPHIA, PA.

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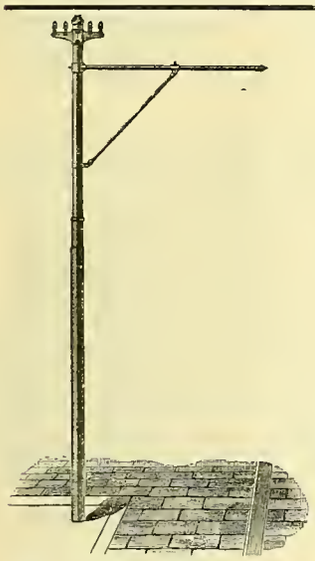

1821.

# MORRIS, TASKER & CO.,

1888.

**INCORPORATED.**

**Offices, 222-224 S. Third St., Philadelphia, Pa.**

**PASCAL IRON WORKS,**
**PHILADELPHIA.**

**DELAWARE IRON WORKS,**
**NEW CASTLE, DEL.**

**Manufacturers of**

## Boiler Tubes, Wrought Iron Pipes and Fittings.

**ELECTRIC LIGHT and RAILWAY POLE POLES A SPECIALTY.**

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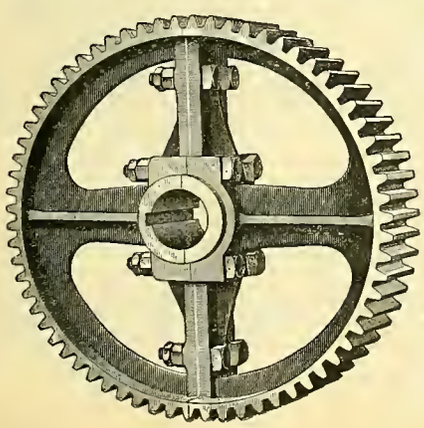
F. A. ESTEP.
President and Treasurer.
J. R. McGINLEY,
Vice-President.
F. S. MARTIN,
Superintendent of Works.



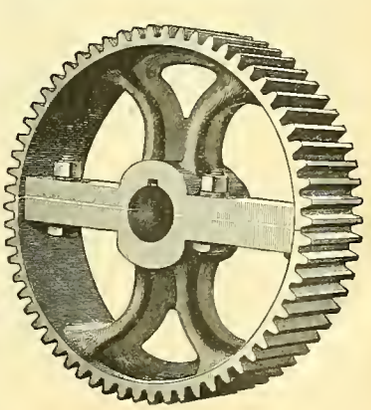
MANUFACTURERS OF

## Electric Railway Supplies.

**GEARS, PINIONS, BEARINGS, TROLLEYS, TROLLEY WHEELS AND HARPS.**

**THIS IS THE IMPROVED NUTTALL TROLLEY.**

**TRY IT ONCE, AND YOU WILL WANT NO OTHER.**



**The largest and most prosperous street railway companies in the country are using our supplies, and they prefer them to all others on account of greater strength and durability. Correspondence solicited.**

CHAS. J. MAYER, 600 Betz Building, Philadelphia, Pa., Middle States Sales Department.
CHAS. N. WOOD, 180 Summer St., Boston, Mass., New England States Sales Department.
STANDARD RY SUPPLY CO., Monadnock Block, Chicago, Ill., N. W. States Sales Department.
A. S. PARTRIDGE, Bank of Commerce Building, St. Louis, Mo., S. W. States Sales Department.
CHAS. A. CAVAGNA, Neave Building, Cincinnati, Ohio, Central States Sales Department.

# CHRISTMAS LIGHTING

Always makes a temporary rush of business for the electric light station. As is always the case, your customer will not place his orders for additional light until the very last moment, and then he will

# WANT IT AT ONCE.

We have been through this holiday rush three or four times, and have learned how to prepare ourselves for it, and are ready this season to assist the station through this trying period by making

# IMMEDIATE SHIPMENT

From Chicago stock of everything that will be required for this work.

**Line Supplies, Paranite Wire, "O. K." Wire, Packard Lamps, Packard Transformers.**

## Electric Appliance Company,

**ELECTRICAL SUPPLIES, 242 MADISON ST., CHICAGO.**

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## Boswell Storage Battery.

For Traction Work, Electric Lighting, Electric Launch, Telegraph, Phonograph, Surgical, and for all purposes where Light and Power are required.

Prices on Application.

**D. E. BOSWELL & CO.,**
154 Lake St., Chicago.

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## OCTAGONAL PINE POLES, NORWAY PINE CROSS-ARMS, WHITE OAK PINS.

**It will pay you to get our prices.**

**BROWNLEE & CO., - Detroit, Mich.**

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The Only Clocks Used in the W. U. Tel. Co. Time Service.

**NO WINDING. CORRECTED HOURLY.**

## SELF-WINDING CLOCK CO.,

26 Broadway, NEW YORK.

*Clocks Sold. Clocks Rented.*

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## Storage Batteries

FOR ALL PURPOSES,
Bradbury-Stone Electric Storage Co.,
LOWELL, - MASS.

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**$24.00 SPECIAL**

To introduce our Dynamos and Motors of larger capacity, we are making a specialty of a high-grade 8-light, 16 C. P., 110 volt Dynamo, retaining all the special features of our larger machines at a surprising low price. Send for circular No. 22.

**ROTH & ECK,** Manufacturers Dynamos and Motors, 34 Market St., Chicago.

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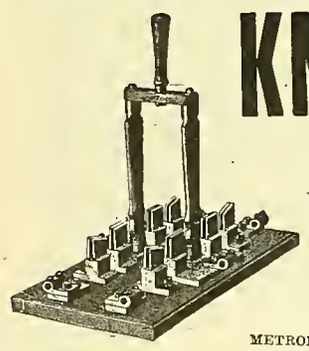

# KNIFE SWITCHES.

HIGH GRADE.

**Our Catalogue No. 2 Mailed for the Asking.**

SUPERIOR WORKMANSHIP.

*Large & Twining,*

319 Chestnut St., PHILADELPHIA, PA.

METROPOLITAN ELECTRIC CO., CHICAGO.

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## "High There!!!"

No more tampering with your meters—
A simple and positive seal.

Prices and samples
By writing to **A. M. WALTER,**
851 The Rookery, Chicago.

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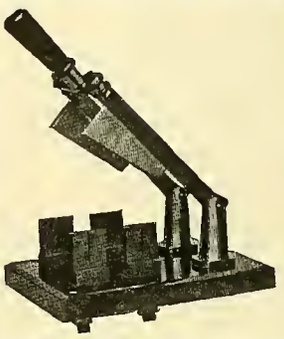
**Switches, Switch-Boards, Tablet-Boards.**



*Estimates and designs furnished on Application.*

Charges reasonable for superior work.

**Technic Electrical Works, 129 Bread Street, PHILADELPHIA.**

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—OF—

All Colors and Descriptions.

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## Automatic Mercurial Pumps

OF LATEST DESIGN

For Incandescent Lamp Companies.

Scientific glass apparatus for Laboratories, Colleges, etc. Reliable workmanship and lowest prices. Agents wanted in Western Cities. **Send for new Catalogue.**

**The Jaeger Mfg. Co.,**

**169 William St., NEW YORK.**

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SEND FOR SAMPLES AND PRICES OF

## SAMSON SPOT CORD

For Arc Light and Trolley Cord.

**SAMSON CORDAGE WORKS, - BOSTON, MASS.**

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# Phœnix Carbon Mfg. Co.,

**S. C. BOOKER, Supt.**

**2134-2140 DeKalb Street, ST. LOUIS, MO.**

# Electric Light Carbons

*We make a specialty of MOTOR and DYNAMO BRUSHES and BATTERY MATERIAL.*

It will pay you to see our product and get our prices before placing your orders.

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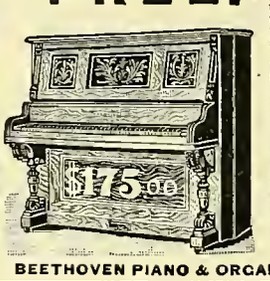
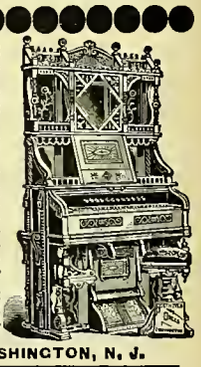



Our 24-page catalogue of Organs, also our new and elegant catalogue of Pianos, containing 16 pp. We have the largest manufactory in the world, from which we sell direct to the consumer at wholesale prices, thus saving the profits of the dealer and the commissions of the agents. We furnish a first-class Organ, warranted 20 years, with stool and book, for only **$27.50**

No money required until instrument has been thoroughly tested in your own house. Sold on instalments. Easy payment.

We positively *guarantee* every Organ and Piano *20 years.* Send for catalogue at once if you want to obtain the greatest bargain on earth. Write *name and address plainly,* and we will send by mail same day letter is received. As an advertisement, we will sell the first Piano of our make in a place for only **$175.** Stool, book and cover free. Regular price, $350.



**BEETHOVEN PIANO & ORGAN CO., P. O. Box 1309 WASHINGTON, N. J.**

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# ROYAL ELECTRIC CO., PEORIA, ILL.

MANUFACTURERS OF

## The Most Reliable ALTERNATING System now on the Market.

**OUR ALTERNATOR HAS:**

NO COLLECTING RINGS. NO COMMUTATOR. NO REVOLVING FIELD OR ARMATURE COILS.

**Step Down TRANSFORMERS.** **Step Up TRANSFORMERS.**

TRANSFORMERS for any desired Voltage. Arc Light TRANSFORMERS. Direct Current Generators and Motors.

CORRESPONDENCE SOLICITED.

Eugene F. Phillips, Prest. W. A. Hathaway, Treas. W. H. Sawyer, Secy.

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BARE AND INSULATED ELECTRIC WIRE,
ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,
Railway Feeder and Trolley Wire,
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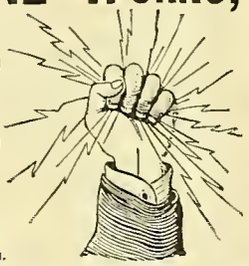

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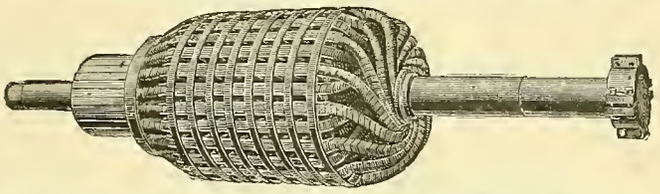

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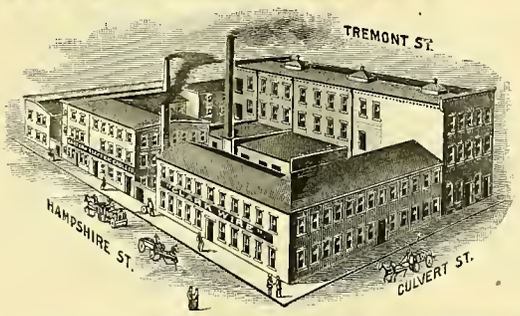


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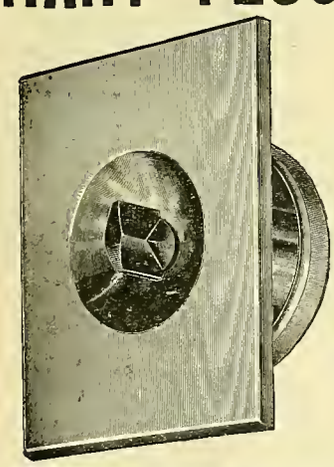

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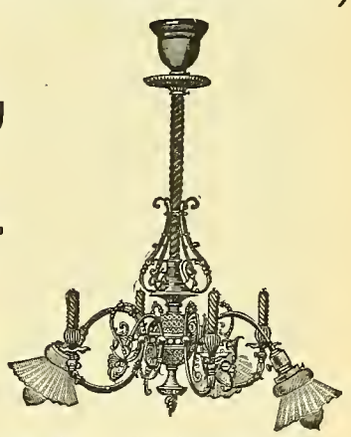

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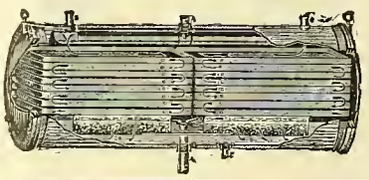

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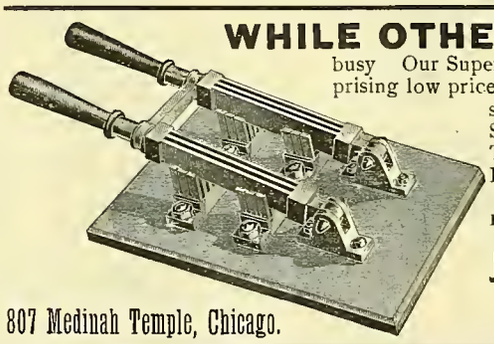

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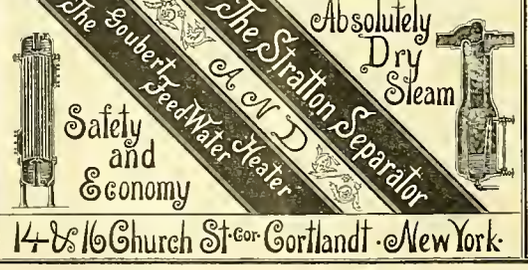


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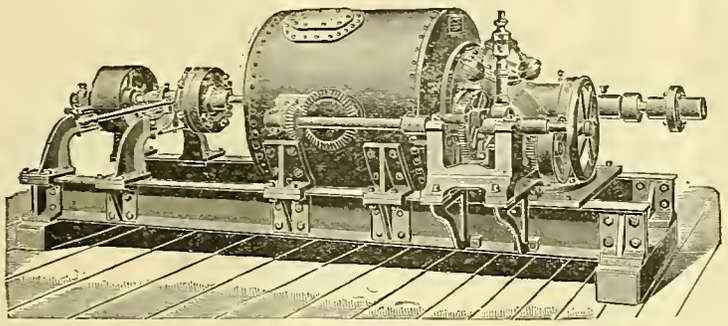

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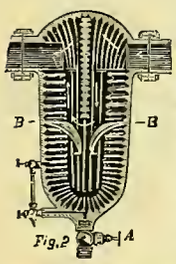


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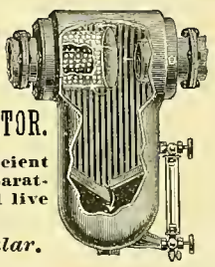

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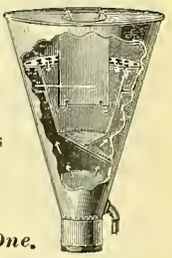

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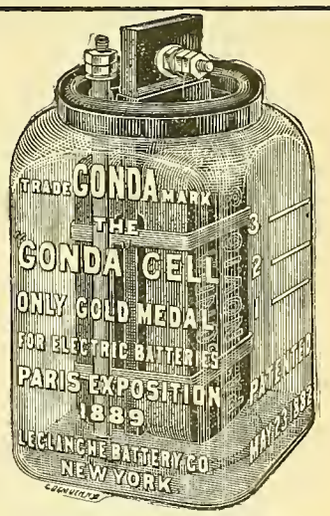


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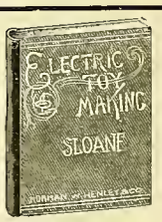

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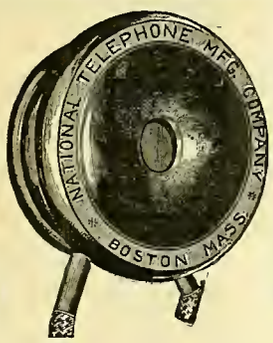


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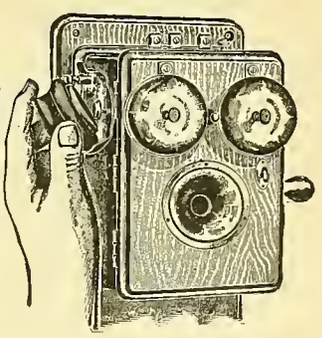

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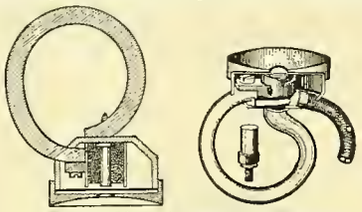
ductor. In the D'Arsonval receiver a curved permanent magnet is used, one pole of which terminates



FIGS. 27 AND 28. D'ARSONVAL RECEIVER.

in a soft iron polepiece that serves as the core of the coil, and the other in an iron box, or cylinder, that

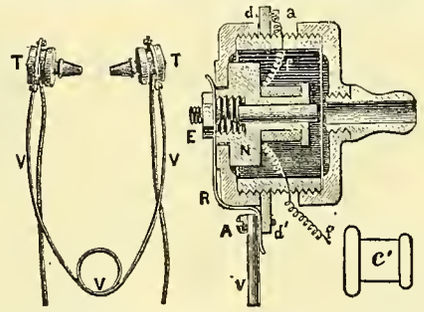



FIG. 29. MERCADIER'S BI-TELEPHONE. *T T* RECEIVERS, *V* SPRING, *N* MAGNET, *E* NUT, *R* STEEL STRIP, *A* SCREW CLAMPING *R* TO *V*, *d d'* METAL COLLAR CLAMPING *V* TO RECEIVER CASE, *f f* TERMINALS OF COIL *a* CONNECTING SCREW, *c'* SOFT RUBBER NIPPLE FOR EARPIECE.

completely encloses the coil. The two poles are magnetically insulated from each other by the wooden case, to the upper part of which the diaphragm is

48 TELEPHONE HAND BOOK.

appeared on the scene with an application for a patent on a microphonic transmitter, and according to the rules of the Patent Office no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbaugh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbaugh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad

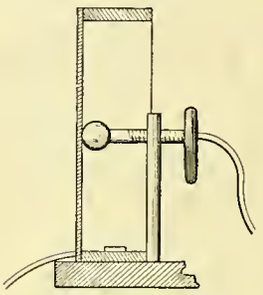


FIG. 44. BERLINER'S FIRST TRANSMITTER.

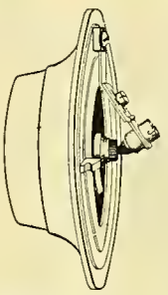


FIG. 45. BERLINER CARBON TRANSMITTER.

principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

78. Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by caus-

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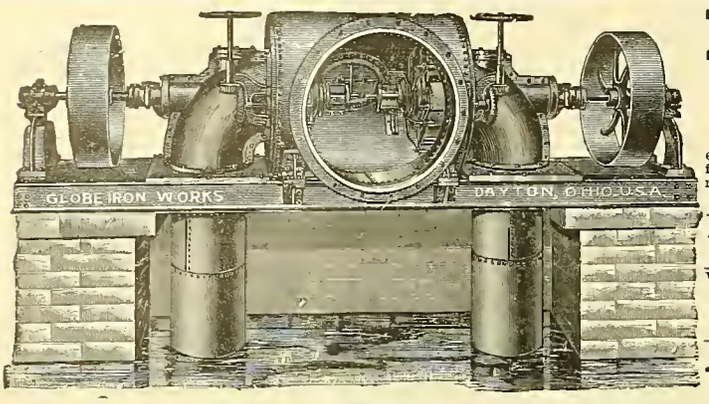


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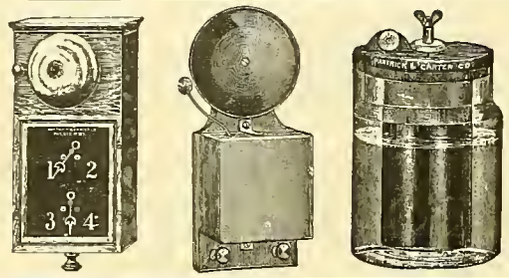

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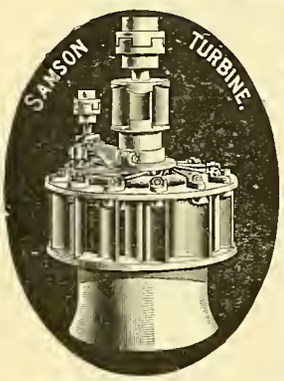


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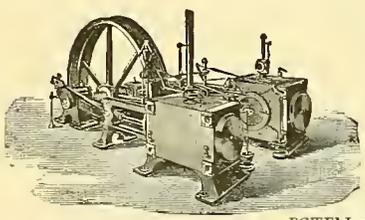

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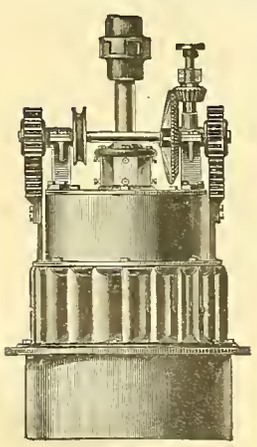

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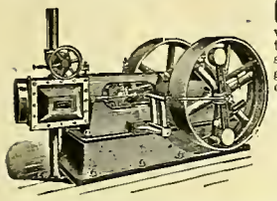

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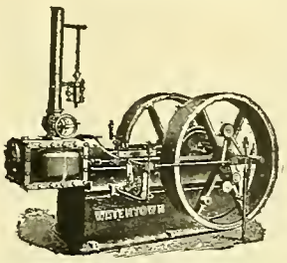

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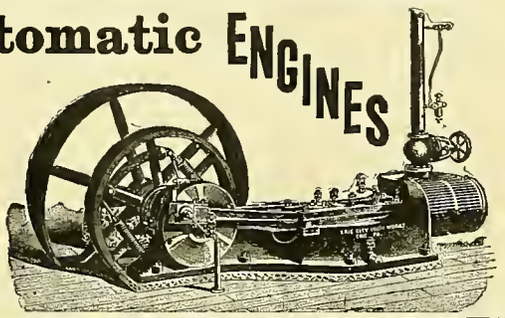

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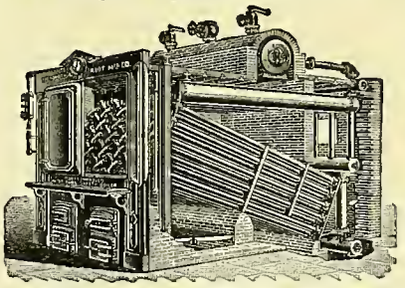

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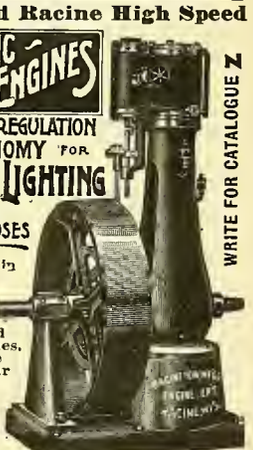

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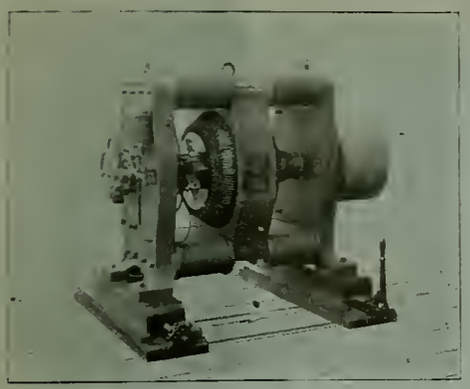

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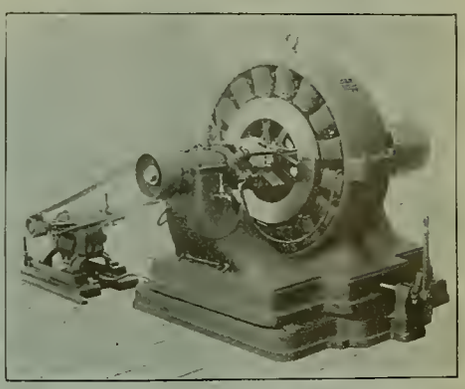

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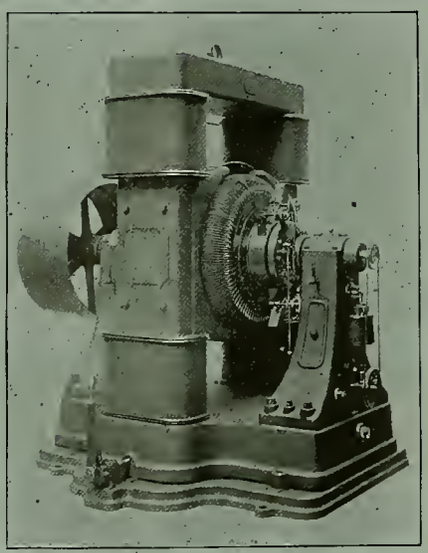

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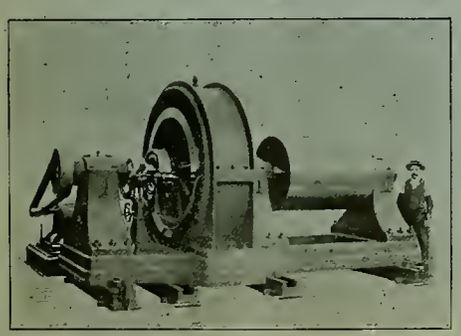

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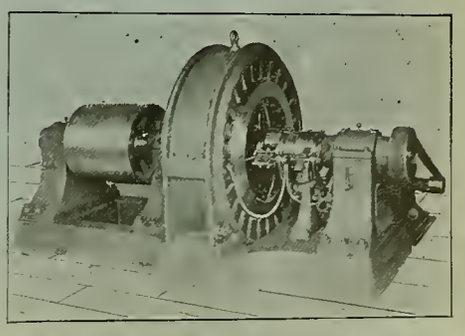

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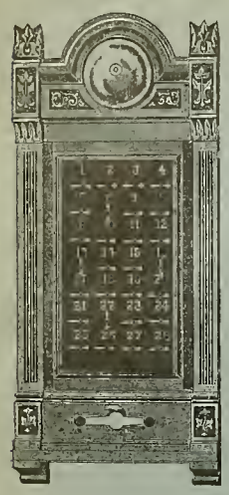

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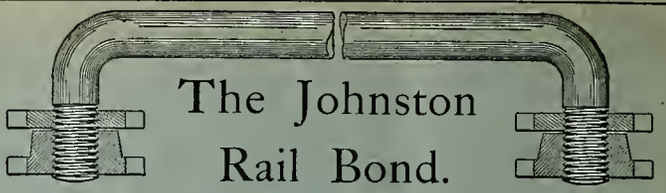

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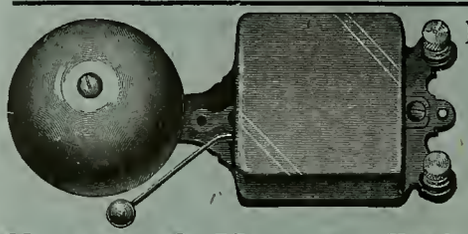

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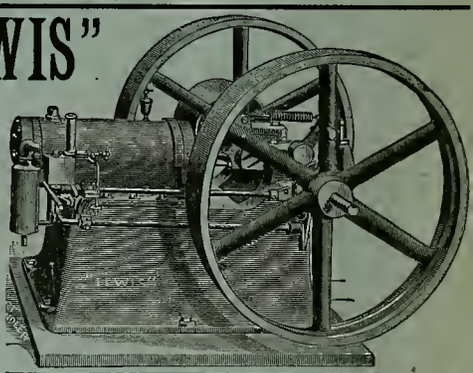

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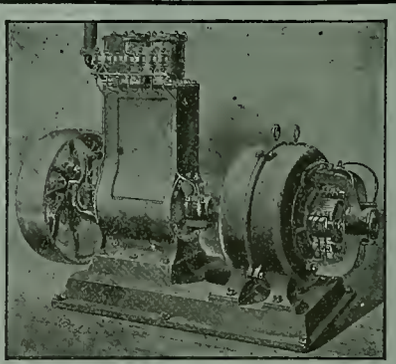

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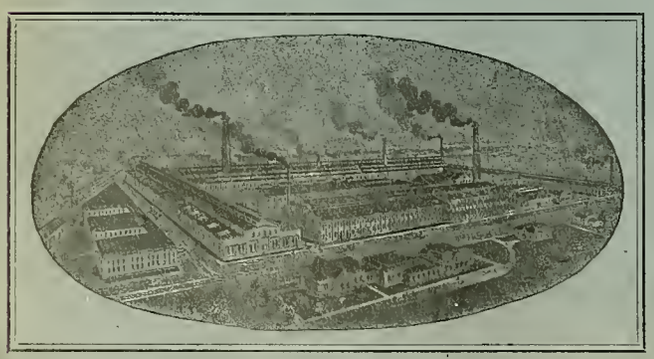

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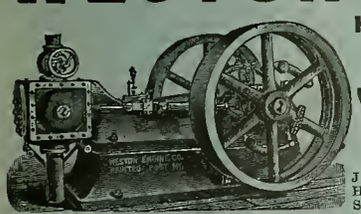

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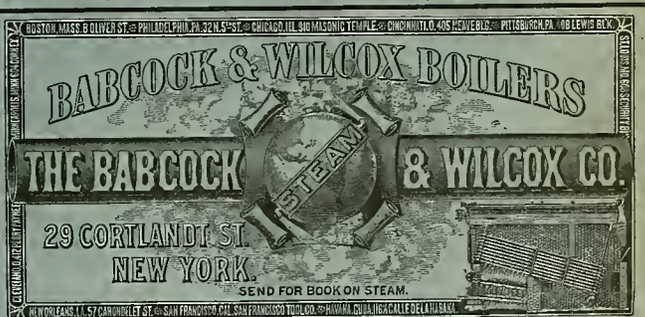


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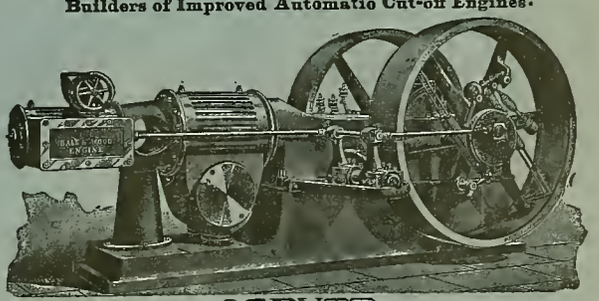

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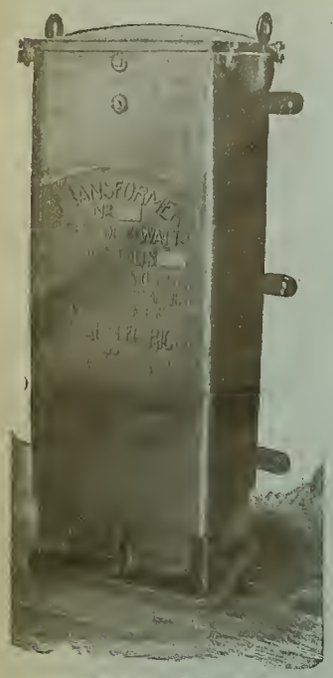

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Boswell & Co., D. E.,
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

**Annunciators.**
Chicago Gen'l Fixture Co.
Dearborn Electric Co.
Electric Applisance Co.
Huebel & Manger.
Lee & Collins.
Ostrander & Co., W. R.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Washington Electric Co.
Western Elec. Supply Co.

**Arc Lamps.**
Auerbach-Woolverton El.Co.
C & C Electric Co.
Clark Electric Co.
Eddy Elec. Mfg. Co.
Electric Cons. & Supply Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
General Ind'd'cent Arc Lt. Co.
Helios Electric Co., The.
Jennings, A. R.
La Roche Electric Wks.
Little, F. P. Elec. C. & S. Co.
Mather Electric Co.
Rushmore, S. W.
Washington Electric Co.
Westinghouse El. & Mfg. Co.

**Arc Light Cord.**
Samson Cordage Wks.

**Armature Winders.**
Rushmore, S. W.

**Batteries and Jars.**
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Dearborn Electric Co.
Electric Appliance Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Law Battery Co.
Leclanche Battery Co., The.
Lee & Collins.
Miamisburg Electric Co.
Partrick & Carter Co.
Phœnix Carbon Mfg. Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Bells.**
Dearborn Electric Co.
Electric Appliance Co.
Huebel & Manger.
Lee & Collins.
Ostrander & Co., W. R.
Partrick & Carter Co.
Proctor-Raymond Elec. Co.
Viaduct Mfg Co.
Western Electric Co.

**Belting.**
Shultz Belting Co.
Phœnix Carbon Mfg. Co.

**Boilers.**
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The.
Brownell & Co., The.
Clonbrock Steam Boiler Wks.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
Racine Hardware Co.
Weston Engine Co.

**Books, Electrical.**
Electrician Publishing Co.

**Brushes.**
Partridge Carbon Co.
Phœnix Carbon Mfg. Co.

**Burglar Alarms.**
Electric Appliance Co.
Lee & Collins.
Partrick & Carter Co.
Wallace Electric Co.
Washington Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cables** (See Insulated Wires.)

**Cables, Electric** . (See Insulated Wires), **Copper, Sheet and Bar.**
American Elec. Works.
Bishop Gutta Percha Co.
Cushing & Morse.
Dearborn Electric Co.
Eastern Electric Cable Co.
Moore, Alfred F.
New York Ins. Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.

**Carbons, Points & Plates.**
General Electric Co.
Partridge Carbon Co.
Phœnix Carbon Mfg. Co.
Reisinger, Hugo.
Washington Carbon Co.
Western Electric Co.

**Clocks, Electric.**
Self-Winding Clock Co.

**Conduits.**
Interior Conduit & Ins. Co.
National Conduit Mfg. Co.

**Construction & Repairs.**
Allen-Hussey Co.
Amstutz, N. S.
C & C Electric Co.
Comstock Co., The Louis K.
Eddy Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Washington Electric Co.

**Contractors and Electric Light Plants.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Brush Electric Co.
Bryan, Wm. H.
C & C Electric Co.
Clark Electric Co.
Comstock Co., The Louis K.
Consolidated Engineering Co.
Dearborn Electric Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Goltz & Sinclair.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
United Elec Improvement Co
Westinghouse Elec & Mfg. Co.
Western Electric Co.

**Copper.**
Law Battery Co.
Miamisburg Electric Co.

**Copper Wires.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Dearborn Electric Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Lee & Collins.
National India Rubber Co
Okonite Co. The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Cordage.**
Samson Cordage Wks.

**Cross-Arms, Pins and Brackets.**
Anderson, Albert & J. M.
Brownlee & Co.
Electric Appliance Co.
Nuttall Co., R. D.
Partrick & Carter Co.

**Cut-Outs and Switches.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Cutter Electrical & Mfg. Co.
Dearborn Electric Co.
Diamond Electric Co.
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Interior Conduit & Ins. Co.
Jennings, A. R.
Large & Twining.
Lee & Collins.
Little, F. P. Elec. C. & S. Co.
Nuttall Co., R. D.
Partrick & Carter Co.
Platt, O. S.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Viaduct Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Dynamos.**
Brush Electric Co.
C & C Electric Co.
Clark Electric Co.
Colburn Electric Mfg.Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Palmer Bros.
Roth & Eck.
Royal Electric Co.
Rushmore, S. W.
Siemens & Halske Elec. Co.
Western Electric Co.
Westinghouse Elec. & Mfg.Co.

**Economizers.**
Fuel Economizer Co.

**Electric Railways.**
Brush Electric Co.
General Electric Co.
Siemens & Halske Elec. Co.
Westinghouse El. & Mfg. Co.

**Electrical and Mechanical Engineers.**
Allen-Hussey Co.
Amstutz, N. S.
Armstrong, Chas. G.
Arnold, B. J.
Ball, Wm. D.
Bryan, Wm. H.
Comstock Co., The Louis K.
Consolidated Eng. Co.
Goltz & Sinclair.
Rushmore, S. W.

**Electrical Instruments.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Dearborn Electric Co.
Diamond Electric Co.
Electric Appliance Co.
Interior Conduit & Ins. Co.
Large & Twining.
Lee & Collins.
Nuttall Co., R. D.
Partrick & Carter Co.
Platt, D. S.
Sweet Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Washington Electric Co.
Western Elec. Supply Co.
Whitney Elec. Instrument Co.

**Electrical Specialties.**
Holtzer-Cabot Electric Co.
Lee & Collins.
Proctor-Raymond Elec. Co.

**Electroliers, etc.**
Chi. Gen'l Fixture Co.
Edwards, W. S. Mfg. Co.
Gleason, E. P. Mfg. Co.
Phœnix Glass Co.

**Electro-Plating Mach'y.**
Colburn Electric Mfg. Co.
General Electric Co.
Rushmore, S. W.

**Engines, Gas.**
Webster Mfg. Co.

**Engines, Steam.**
Ball & Wood Co., The.
Brownell & Co., The.
Erie City Iron Wks.
Freeman & Sons Mfg. Co.
McEwen Mfg. Co., J. H.
Racine Hardware Co.
Sioux City Eng & Iron Wks.
Watertown Steam Engine Co.
Weston Engine Co.

**Fan Outfits.**
Interior Conduit & Ins. Co.

**Feed Water Heaters.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Fibre.**
Butler Hard Rubber Co.
Kartavert Mfg. Co.
Standard Paint Co.
Vulcanized Fibre Co.

**Fire Alarms.**
Butler Hard Rubber Co.
Partrick & Carter Co.
Western Electric Co.

**Fuse Wire.**
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Jennings, A. R.
Lee & Collins.

**Gas Lighting, Electric.**
American Electric Co.
Holtzer-Cabot Electric Co.
Lee & Collins.
Partrick & Carter Co.

**Gears.**
Grant, Geo. B.
Nuttall Co., R. D.

**General Elec. Supplies.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bryant Electric Co.
Bunnell & Co., J. H.
Chicago Gen'l Fixture Co.
Colgate Co., Geo. L.
Cutter Electrical & Mfg. Co.
Dearborn Electric Co.
Electric Appliance Co.
General Electric Co.
High & Co., J. Grant.
Holtzer-Caoot Electric Co.
Interior Conduit & Ins. Co.
Lee & Collins.
Large & Twining.
Little, F. P. Elec. C. & S. Co.
Palmer Bros.
Partrick & Carter Co.
Platt, O. S.
Proctor-Raymond Elec. Co.
Sioux City Brass Works.
Sweet Elec. & Mfg. Co.
Technic Electrical Wks.
Viaduct Mfg. Co.
Washington Electric Co.
Wallace Electric Co.
Western Elec. Supply Co.

**Globes and Electrical Glassware.**
Chicago Gen'l Fixture Co.
Gleason, E. P. Mfg. Co.
Jaeger Mfg. Co., The.
Phœnix Glass Co.

**Graphite Specialties.**
Dixon Crucible Co., Jos.

**Hard Rubber Goods.**
Butler Hard Rubber Co.

**Induction Coils.**
Splitdorf, C. F.

**Insulators and Insulating Materials.**
Anderson, Albert & J. M.
Bernard Co., The E. G.
Bunnell & Co., J. H.
Butler Hard Rubber Co.
Chicago Gen'l Fixture Co.
Cutter Elec. & Mfg. Co.
Dearborn Electric Co.
Electric Appliance Co.
Empire China Works.
Hart & Hegeman Mfg. Co.
High & Co., J. Grant.
Holtzer-Cabot Electric Co.
Interior Conduit & Ins. Co.
Johns Mfg. Co., H. W.
Kartavert Mfg. Co.
Large & Twining.
Lee & Collins.
Little, F. P. Elec. C. & S. Co.
Munsell & Co., Eugene.
National India Rubber Co.
New York Insulated Wire Co.
Nuttall Co., R. D.
Okonite Co., The.
Paragon Insulating Co.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Platt, O. S.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.
Technic Electrical Wks.
Wallace Electric Co.

**Insulated Wires and Cables—Magnet Wire.**
American Electrical Works.
Bishop Gutta Percha Co.
Bunnell & Co., J. H.
Cushing & Morse.
Dearborn Electric Co.
Eastern Electric Cable Co.
Electric Appliance Co.
General Electric Co.
Independent Electric Co.
Lee & Collins.
Moore, Alfred F.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Partrick & Carter Co.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Wallace Electric Co.
Western Electric Co.
Western Elec. Supply Co.

**Lamps, Incandescent.**
Am. Electrical Mfg. Co.
Beacon Vac Pump & Elec.Co.
Bernstein Electric Co.
Buckeye Electric Co.
Dearborn Electric Co
Electric Appliance Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Jaeger Mfg. Co., The.
New York & Ohio Co.
Partrick & Carter Co.
United Elec. Imp. Co.
Westinghouse Elec. & Mfg. Co.

**Lightning Arresters.**
Colgate Co., Geo. L.
Diamond Electric Co.
Electric Appliance Co.
General Electric Co.

**Magnet Wire.**
(See Insulated Wires.)

**Mechanical Machinery.**
Bliss Co., E. W.
Hine & Robertson Co.

**Mica.**
Johns Mfg. Co., H. W.
Munsell & Co., Eugene.

**Mining Apparatus, Elec.**
General Electric Co.
Independent Electric Co.
Westinghouse El. & Mfg. Co.

**Motors.**
Brush Electric Co.
C & C Electric Co.
Colburn Electric Mfg. Co.
Eddy Elec. Mfg. Co.
Fontaine Crossing & El. Co.
Ft. Wayne Elec. Corporation.
General Electric Co.
Interior Conduit & Ins. Co.
La Roche Electric Wks.
Mather Electric Co.
Palmer Bros.
Royal Electric Co.
Roth & Eck.
Rushmore, S. W.
Sioux City Brass Works.
Stanley Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Wallace Electric Co.
Westinghouse El. & Mfg. Co

**Packing.**
Garlock Packing Co.

**Paints.**
Lee & Collins.
Paragon Insulating Co
Standard Paint Co.

**Patents.**
Gooch, Chas. J.

**Phosphor Bronze.**
Phosphor Bronze Sm.Co. Ltd

**Pianos and Organs.**
Beethoven Piano & Organ Co.

**Platinum.**
Baker & Co.

**Poles.**
Brownlee & Co.
Morris, Tasker & Co.
Nuttall Co., R. D.

**Porcelain.**
Empire China Works.
General Electric Co.
Jennings, A. R.
Phœnix Glass Co.

**Publishers, Electrical.**
Electrician Publishing Co.

**Push Buttons.**
Electric Appliance Co.
Huebel & Manger.
Partrick & Carter Co.

**Rheostats.**
General Electric Co.
Rushmore, S. W.

**Sal Ammoniac.**
Klipstein, A. & Co.
Law Battery Co.

**Second-Hand Electrical Machinery.**
Rushmore S. W.

**Separators.**
Goubert Mfg. Co.
Hine & Robertson Co.

**Silk Braid.**
Boston Braid Mfg. Co.

**Slate.**
Jennings, A. R.

**Speaking Tubes.**
Electric Appliance Co
Lee & Collins.
Ostrander & Co., W. R.
Partrick & Carter Co

**Speed Indicators**
Colgate Co., Geo. L.
Diamond Electric Co
Whitney Elec. Instrument Co.

**Steam Heating.**
Goubert Mfg. Co.
Webster & Co., Warren.

**Steam Pumps.**
Worthington, Henry R.

**Storage Batteries.**
Boswell & Co., D. E.
Bradbury-Stone Elec. S. Co.
Cons. Electric Storage Co.
Electric-Power Storage Co.
Electric Storage Battery Co.
Haschke & Creelman.
Porter & Buerdorf.

**Street Cars.**
Brill, J. G. Co.

**Tapes, Insulating.**
American Electrical Works.
Cushing & Morse.
Electric Appliance Co.
Lee & Collins.
Moore, Alfred F.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Simplex Electrical Co.
Standard Paint Co.

**Telegraph Apparatus.**
Electric Appliance Co.
Partrick & Carter Co.
Western Electric Co.

**Telephones**
Columbia Tel. Mfg. Co.
National Telep. Mfg. Co.
Palmer Bros.
Partrick & Carter Co.
Viaduct Mfg. Co.
Western Electric Co.
Western Tel. Const. Co.

**Telephone Hooks.**
Bradley & Co.

**Transformers.**
Diamond Electric Co.
General Electric Co.
Hornberger Elec. Mfg. Co.
Ft. Wayne Elec. Corporation.
Jennings, A. R.
Royal Electric Co.
Stanley Electric Mfg. Co.
Wagner Elec. Mfg. Co
Wallace Electric Co.
Western Elec. Supply Co

**Trolley Cord.**
Samson Cordage Wks

**Trucks, Electric Car.**
General Electric Co.
Westinghouse El. & Mfg. Co.

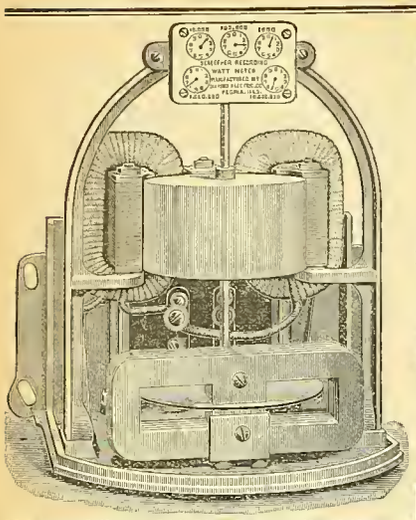
**Turbine Wheels.**
Dayton Globe Iron Works Co.
Leffel & Co., Jas.
Smith, S. Morgan.
Stillwell-Bierce & Smith-Vaile Co.

**Universities.**
Cor. School of Industrial Sciences.
Scientific Machinist Co.

**Varnishes.**
Lee & Collins.
Standard Paint Co.

**Water Wheels.**
Leffel & Co., Jas.
Smith, S. Morgan.

**Wire, Bare.**
Anderson, Albert & J. M.
Bishop Gutta Percha Co.
Electric Appliance Co.
Independent Electric Co.
National India Rubber Co.
Nuttall Co., R. D.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.



Chicago Office, 1307 Manhattan Building,
Central Electric Co., Selling Agents.

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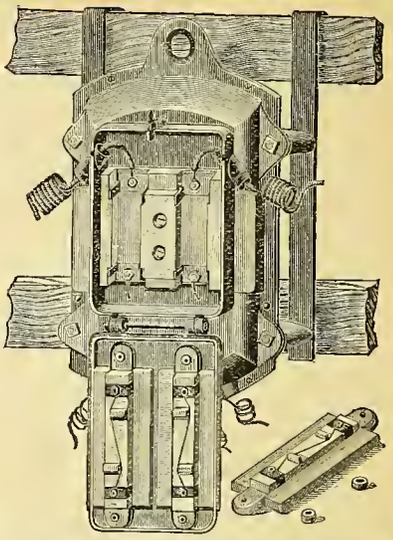
For Alternating Circuits. No Commutator. No Brushes.

Registers Direct Actual Power Consumed.

EASILY ADJUSTED. ABSOLUTELY RELIABLE.



# DIAMOND TRANSFORMER.

Simplest, Safest and Best.

FOR ANY VOLTAGE. FOR ALL SYSTEMS.

## DIAMOND ELECTRIC CO., Peoria, Ill.

# TELEPHONE WIRE AND CABLES.

Every Telephone Company in the United States is using Kerite Wire and Cables. Kerite is the Standard of High Grade Insulation, and will Cut Last and Out Class any other on the Market.

SEND FOR SAMPLES AND PRICES.

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**W. R. BRIXEY, Mfr.**
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# ARC LAMPS FOR INCANDESCENT CIRCUITS,

**Both Alternating and Direct.**

Standard "Ward" Lamps, - $10 Each

TWO IN SERIES ON 110 VOLTS. Globe and Resistance, $2 extra per lamp.

A COMPLETE LINE of ENTIRELY NEW Arc Lamps.

SIMPLEST. STRONGEST. SUREST FEED.

Easiest and Cheapest to Maintain.

SPECIAL LAMPS OF ALL KINDS.

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We carry a stock of FIDELITY carbons and IMPORTED CORED carbons, which we are selling at reduced prices.

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18 Cortlandt Street, New York.
(Established 1881.)

Wallace Electric Co., Agents, 307 Dearborn Street, Chicago, Ill.

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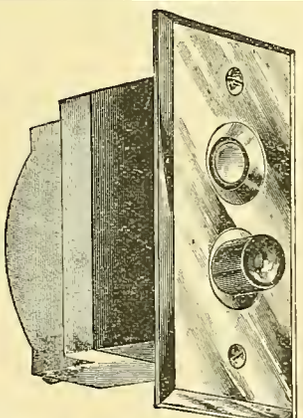
**C-S Flush Double Push Switch.**
Single Pole—Double Pole—Commutation; 3 Wire, 4 Wire.

**C-S Flush Key Switch.**
Single Pole—Double Pole—3 Wire.

**C-S Flush Automatic Switch.**
Single Pole.

ELECTRICALLY
MECHANICALLY
ARTISTICALLY **PEERLESS.**

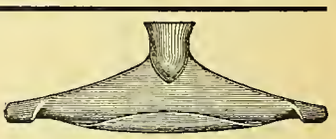


C-S Flush Double Push Switch—Double Pole.

## THE CUTTER ELECTRICAL & MFG. CO.,

*27 So. 11th Street, Philadelphia, Pa., U. S. A.*

# "H. W. J." MECHANICAL CLIP.



An exceedingly simple and practical device consisting of a single casting—no parts to break or get out of order. Provides a straight underrun for and does not damage the trolley wheel. It holds the wire securely and is practically non-sparking. It is safe, economical and saves time.

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240 & 242 Randolph St.,
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New York. Philadelphia. Boston.

# HELIOS CORED CARBONS For Alternating and Direct Currents.

Attempts have been made in this country to produce a satisfactory cored carbon, but failure resulted in every case. We can now assure the Electric Light Companies that our "HELIOS" CARBON is made of the same ingredients, in precisely the same way,

**By the man who made them in Germany.**

We shall be glad to hear from the Electric Light interests of the country in relation to carbons for both alternating and Direct Currents. A memorandum book, with tables showing the relation between millimeters and inches, with a list of ordinary sizes of "HELIOS" CARBONS of our manufacture will be sent on application. **Reduced Prices on Solid Carbons for Series Arc Lighting.**

## A · Departure · In · Business · Methods!

*NOTE THIS OFFER:—Let us know by telegraph the price you are now paying, stating yearly consumption, and we will guarantee to beat it from 50 cents to $2.00 per thousand.*

# THE WASHINGTON CARBON COMPANY, - PITTSBURG, PA.

THE

# Chloride Accumulator.

The Electric Storage Battery Company has acquired all the patents and patent rights concerning the manufacture of electric storage batteries of the General Electric Company, the Edison Electric Light Company, the Thomson-Houston Electric Company, the Brush Electric Company, The Accumulator Company, The Consolidated Electric Storage Company and the General Electric Launch Company, whereby The Electric Storage Battery Company has secured to itself the sole right to supply in the United States electric storage batteries of all the various important types heretofore developed, as well as the protection of every decision heretofore rendered by the United States courts in the interpretation of electric storage battery patents.

The acquisition of these patents not only terminates all litigation heretofore existing, but insures the company against any future attacks, as the patents acquired, together with those originally owned by The Electric Storage Battery Company, cover all the known principles involved in storage batteries.

The Company has also increased largely its cash working capital, and is fully prepared to fill all orders for storage batteries promptly.

Catalogue containing full description of the various types of elements, weights, capacities, dimensions, etc., and price list, furnished on application.

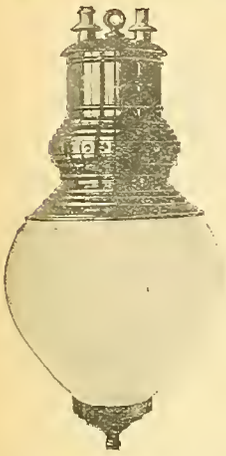
## THE ELECTRIC STORAGE BATTERY CO.,

838 DREXEL BUILDING, PHILADELPHIA.

# THE HELIOS

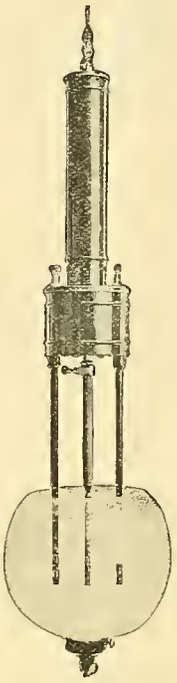
## New Alternating Arc Lamp

### For Street Lighting

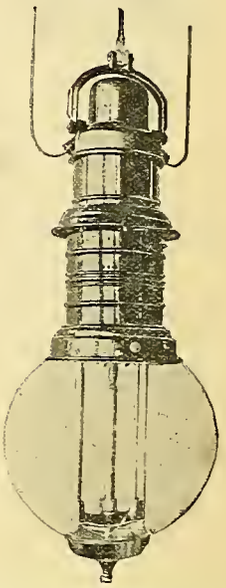


No. 13.
Ipeide 7 Ampere 7 Hour Lamp.

New Alternating Lamp 900 c. p., 7 amperes at 28 volts or 4½ amperes at 50 volts, 2¼ amperes at 100 volts. It consumes the energy of 3½ 16 c. p. incandescent lamps. A small alternating lamp is only possible with a reflector plate.



We have just completed a new direct current lamp which we guarantee will not SEE-SAW. The mechanism is entirely novel. By means of this arrangement the most troublesome feature in running lamps in series is eliminated.



No. 10.
Street Lamp, either 12 or 14 hour, to be used in connectioo with Special 33 Volt Transformer.

*Low Potential*
*Direct Current Lamps*

Write us for Prices and Discounts

Eastern Agents: STANLEY ELECTRIC MFG. CO., Pittsfield, Mass.
Western Agents: CENTRAL ELECTRIC CO., Chicago, Ill.
Southwestern Agents: ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis, Mo.
New York City Agents: GLOBE ELECTRICAL SUPPLY & CONSTRUCTION CO., Vandam and Greenwich Streets.
MOUNTAIN ELECTRIC CO., Denver, Col., Agents for Colorado, Utah, Wyoming and New Mexico.
MACHINERY SUPPLY CO., Los Angeles, Cal., Agents for Lower California and Arizona.
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**Helios Electric Company** PHILADELPHIA, PA.

# THE S. K. C. SYSTEM OF
# Two-Phase Alternating Current Apparatus.

***The first and only complete and perfected system by which light and power can be supplied from the same generator. Power transmission and distribution made practical and commercially successful.***

In construction and operation the entire system is much more simple than any other, either direct or alternating.

The superior efficiency of the generator is in itself a handsome profit to any station.

It is practically self-regulating without the loss of energy involved by compounding or compensating.

The usual sources of trouble and expense have been entirely eliminated from this generator; *i. e.* the revolving armature, commutators, collector rings, brushes, etc.

They can be built for any voltage from 110 for isolated lighting to 5,000 for power transmission work.

The motors excel in simplicity of construction; in starting torque and simplicity of starting device; in efficiency in the manner in which they take current in proportion to their load, and in the uniformity of speed under the different conditions of load.

Our transformers insure satisfactory service and the greatest economy. We are prepared to fill all orders promptly, and carry a full stock of transformers in Chicago.

"No practical station man who has seen a Stanley alternator in operation will ever be satisfied with any other."

# Stanley Electric Mfg. Co.,

**Western Office, 307 Dearborn St., CHICAGO.** PITTSFIELD, MASS.

# TELEPHONES.

## THE VIADUCT CO., BALTIMORE,

Has made more **MAGNETO TELEPHONE BELLS** than all the manufacturers in the United States combined, with one exception. Their superiority over **ALL** others is fully acknowledged by those who have used them continuously during the past **SIXTEEN** years, and it will not depart from this record of making the **BEST**. The standard workmanship will be maintained with its

**TELEPHONES.**

Purchasers and users will appreciate this, that with a CHEAP bell the Telephone is useless, because you must first attract the attention of your correspondent, and if the bell (which is the essential instrument of the set) does not ring, you may as well be without the Telephone.

Our **ARM REST** Bell, patented May 30, 1893, is a success. This company MANUFACTURES and guarantees everything it sells, and has been doing so twenty-three years. Send for catalogue, enclose business card and mention this paper.

**VIADUCT MFG. CO., 8 So. Howard St., Baltimore, Md.**

The most Powerful Receiver Known—Patented May 29, 1894.

"NATIONAL" COMPOUND RECEIVER.

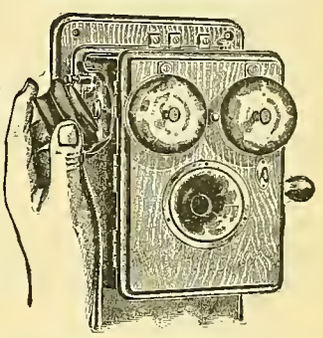
# The "NATIONAL."

We make simply a business proposition. Buy two sets of our instruments and make your own tests. If satisfactory the way is open for more business, either in telephones or switchboards for exchanges.

Our head telephones are largely used by Bell telephone operators.
The "NATIONAL" is in use at the U. S. Military Academy, West Point, N. Y.

## NATIONAL TELEPHONE MFG. CO.,

**620 (W) Atlantic Avenue, Boston, Mass.**



"NATIONAL." Method of Placing Receiver in Holder.

WHY PAY RENT?

# THE COLUMBIA

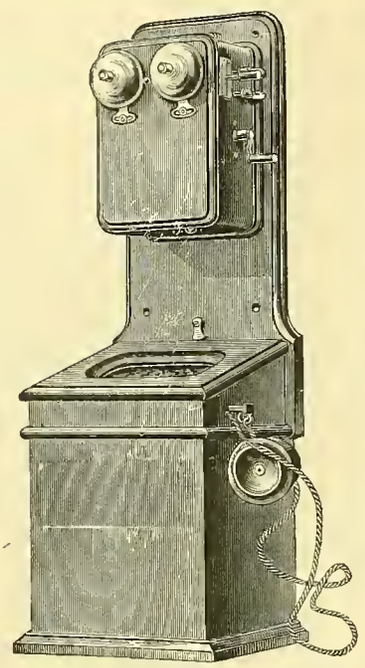
THE LATEST AND BEST.

PATENTS FUNDAMENTAL—NON-INFRINGING.

## Why Not Own Your Telephone?

**LONG DISTANCE BATTERY TRANSMITTERS**

of the latest and newest designs sold outright. No adjustment. Nothing to get out of order. Nothing demanding repair. Will convey articulate speech 1,000 miles. Constructed of the best material.



**A TELEPHONE RECEIVER**

of the newest and best pattern. Unique in design. Perfect in action. Moderate in cost. Small instruments made of the finest rubber. All wires and connections within the case. No unsightly thumbscrews.

This Company owns the patent for the improved Switch for changing the circuit of the Telephone on battery transmitters. Also for perfected system of telephone exchanges. The best DRY BATTERY manufactured. Send for Circular.

# THE COLUMBIA TELEPHONE MANUFACTURING CO.,

**136, 138, 140 Front St., New York City.**

# THE C & C ELECTRIC COMPANY

MANUFACTURERS OF

## MULTIPOLAR DYNAMOS,

Direct Driven or Belted, in sizes up to 250 H. P.

## BIPOLAR DYNAMOS,

Up to 100 H. P.

Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated lighting plants, Central Station Apparatus.

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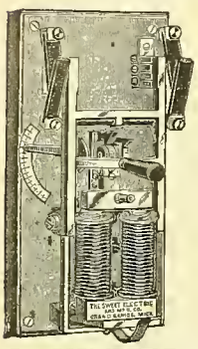
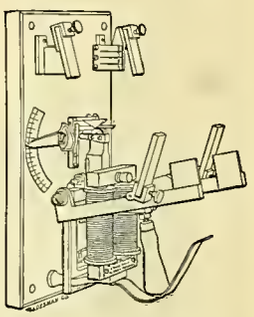
BRANCH OFFICES: CHICAGO, 1020 and 1021 Monadnock Building. BOSTON, 63 Oliver St.
CLEVELAND, Cuyahoga Building. PHILADELPHIA, 633 Arch St.

# Hot Stuff.



No! we make the final break off from carbons so that it is impossible to get heat enough to fuse points of your copper contact plates; no filing off of rough points, no hanging on after you have had a short circuit or over load, bound to work as easily after opening 1,000 times as it does when opened the first time.

**WE KNOW YOU NEED OUR CIRCUIT BREAKER,** and do not see why you should delay writing us any longer. One burn out will pay for a dozen of our instruments. **To be used on the Alternating or Direct Current Systems.**



**WRITE US AT ONCE.**

## SWEET ELECTRIC & MFG. CO.,

GRAND RAPIDS, MICH.

# We Want Western Business.

## LA ROCHE ALTERNATORS.

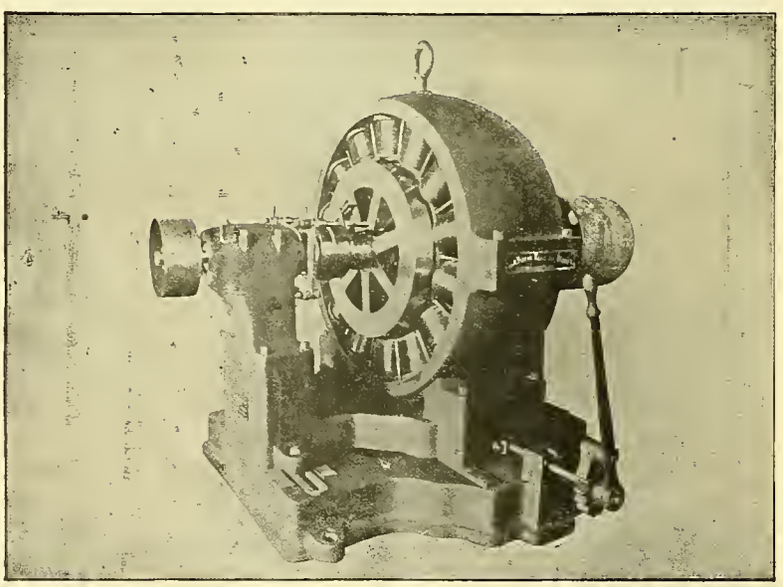
Manufactured in Sizes from

**25 to 5,000 Lights,**

**SINGLE**
OR
**MULTIPHASE.**

Direct Connected Dynamos.

Direct Current Generators.



1,000 Light Alternator.

**LA ROCHE ELECTRIC WORKS,**

PHILADELPHIA, PA.

DISTRICT OFFICES:

New York, Boston, Knoxville, Cincinnati, Pittsburg, San Francisco, Chicago, St. Louis, Mobile.

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OWEN FORD, Rialto Bldg., St. Louis, Mo.

TO SAY THAT THE STANDARD SINGLE PUSH FLUSH SWITCH IS

# "IN THE PUSH"

WIRES AND CABLES

WIRES AND CABLES

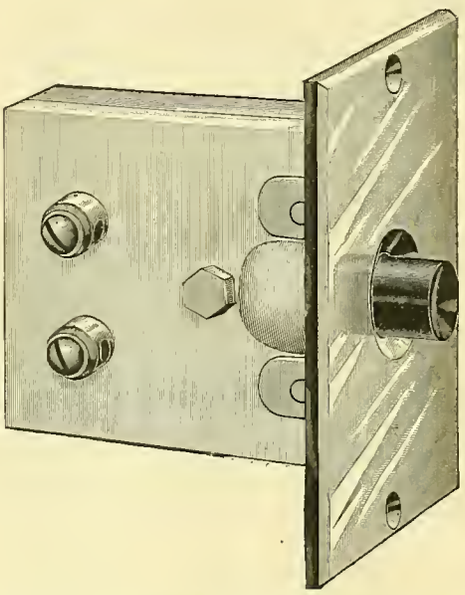
WIRES AND CABLES

WIRES AND CABLES

WIRES AND CABLES

May not be a very desirable expression to appear in the belles lettres of electrical literature, but it expresses a truth that is rapidly being appreciated by the electrical trade.

"A GOOD THING.



'PUSH' IT ALONG."

**A SINGLE BUTTON CONTROLS ONE OR MORE LIGHTS.**

**Single Pole. Three-Way. Commutation.**

All porcelain insulation with flush metal face plate, which is furnished in special finishes to match hardware, etc., to order.

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WIRES AND CABLES

GENERAL SELLING AGENTS:

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ELECTRICAL SUPPLIES.

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GENERAL WESTERN AGENTS

Paranite Wires and Cables, "O. K." Weatherproof Wires and Cables.

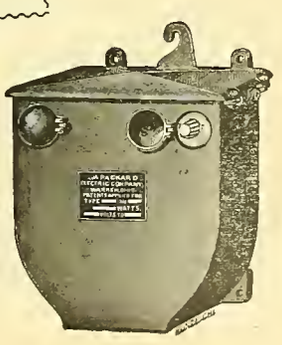
AND REPRESENTING

NEW YORK & OHIO COMPANY, Warren, Ohio,

MANUFACTURERS OF THE PACKARD LAMP;

PACKARD ELECTRIC COMPANY, Warren, Ohio,

MANUFACTURERS OF THE PACKARD TRANSFORMER.



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It will pay you to get our prices.

BROWNLEE & CO., - Detroit, Mich.

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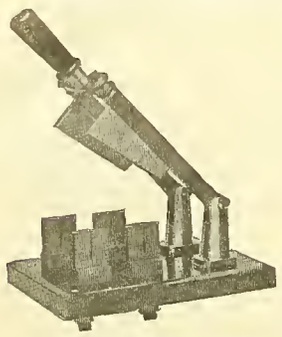
**Switches, Switch-Boards, Tablet-Boards.**



*Estimates and designs furnished on Application.*

Charges reasonable for superior work.

Technic Electrical Works, 129 Bread Street, PHILADELPHIA.

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All Colors and Descriptions.

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**Automatic Mercurial Pumps**

OF LATEST DESIGN

For Incandescent Lamp Companies.

Scientific glass apparatus for Laboratories, Colleges, etc. Reliable workmanship and lowest prices. Agents wanted in Western Cities. **Send for new Catalogue.**

The Jaeger Mfg. Co.,

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THE

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HORNBERGER ELECTRIC MFG. CO.,

ELKHART, INDIANA.

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**Boswell Storage Battery.**

For Traction Work, Electric Lighting, Electric Launch, Telegraph, Phonograph, Surgical, and for all purposes where Light and Power are required.

Prices on Application.

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**The Wirt Dynamo Brush.**

Suitable for all Incandescent Dynamos, Plating Dynamos, Alternating Generators and Exciters, Electric Railway Generators, Stationary Motors.

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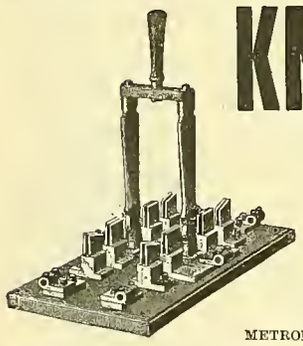

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HIGH GRADE.

Our Catalogue No. 2 Mailed for the Asking.

SUPERIOR WORKMANSHIP.

*Large & Twining,*

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Successors to T. C. RAFFERTY & CO.,

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**INVITE** your attention to their new catalogue which will be ready for distribution in about ten days. Hold **YOUR** orders until you receive it, and if we haven't your name be sure to send it to us at once. Also send your orders if you cannot wait for the catalogue. Particularly on **ORDERS**

## BISHOP WIRES AND CABLES,

acknowledged by all to be the very best obtainable. The prices are very reasonable. Call on us when in the city.

**DEARBORN ELECTRIC COMPANY,**

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The Only Clocks Used in the W. U. Tel. Co. Time Service.

NO WINDING. CORRECTED HOURLY.

SELF-WINDING CLOCK CO.,

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*Clocks Sold. Clocks Rented.*

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GLOSSY BLACK FINISH.
DRIES AT ONCE.
ADHESIVE. FLEXIBLE.
ACID AND OIL PROOF.
WATER AND WEATHER PROOF.

The Paragon Insulating Co.,

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# The BISHOP GUTTA-PERCHA CO.

THE BEST GRADES OF

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For under ground, under water, and all other conditions.

Address 420-426 East 25th Street, - - NEW YORK.

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AGGREGATING IN CAPACITY 260,425 Horse Power, ARE NOW IN USE.

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The Western Office of the

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Will represent the Porcelain Business of R. Thomas & Sons Co.

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Hard Vitreous Porcelain Knobs, Tubes and Insulators.

*Bryant Electric Company make good goods and prompt shipments. All first class supply houses carry them in stock and can fill orders quickly when the Bryant make is specified.*

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**SAMSON SPOT CORD**

For Arc Light and Trolley Cord.

SAMSON CORDAGE WORKS, - BOSTON, MASS.

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# For Electrical Purposes

Guaranteed 98/99% and free of lead and iron. If you want the best quality ask your dealer for this brand. Imported by

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## BARE AND INSULATED ELECTRIC WIRE,

ELECTRIC LIGHT LINE WIRE,
INCANDESCENT AND FLEXIBLE CORDS,

## Railway Feeder and Trolley Wire,

AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES.

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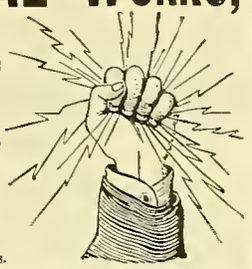

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CHICAGO STORE, F. E. Donohoe, 241 Madison St.
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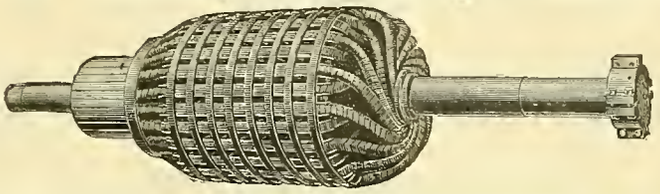
# COOL HEADED ARMATURES

Are Necessary for All-around Station Economy.



The above cut is of a 175 K. W. Generator wound on our new open-head spiral system. All coils alike, perfect balance, handsome appearance. Write for prices on **HEAVY CENTRAL STATION REPAIRS**; *Large Commutators*, Search Lamps and Station Dynamos.

Shops, Jersey City, N.J. **S. W. RUSHMORE,** 126 Liberty St., NEW YORK.

THE

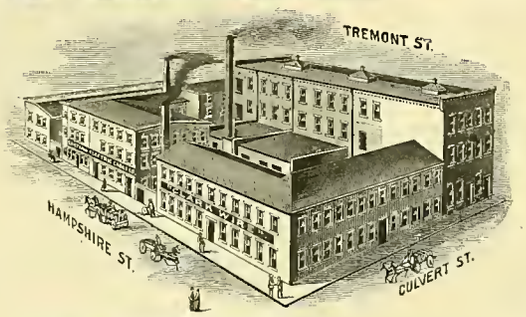
# "CLARK" WIRE.

TRADE MARK.

For Switchboard, Railway and Motor use, we make all sizes of Stranded and Flexible Wire and Cables with Clark's Insulation.

The Clark Wire has been before the public and in use for the past nine years, and has met with universal favor. Thousands of miles of this wire have been sold, and are in use throughout the United States and Foreign Countries, and the demand for it is constantly increasing, because it always gives perfect satisfaction.

HENRY A. CLARK, Treas. and Gen'l Mgr.
HERBERT H. EUSTIS, Prest. and Electrician.




In a Letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A Thoroughly Reliable and Desirable Wire in every respect."

The Rubber used in insulating our Wires and Cables is especially chemically prepared, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat.

We guarantee our Insulation wherever used, Aerial, Underground or Submarine, and our net prices are as low, if not lower, than any other first-class Insulated Wire.

We shall be pleased to mail Catalogues with Terms and Discounts for Quantities.

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61 and 63 Hampshire St., Boston, Mass.

**Send for Catalogue.**

Dynamos and Motors and Parts of Same
ALL KINDS PRICES OF PARTS **TELEPHONES** ELECTRICAL SUPPLIES
SEND STAMP FOR CATALOGUE **PALMER BROS.** MANUS, CONN.

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**BRUSH PATENTS,**
Licenses Granted.
EDISON BUILDING, NEW YORK.
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# Phœnix Carbon Mfg. Co.

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# Electric Light Carbons

*We make a specialty of MOTOR and DYNAMO BRUSHES and BATTERY MATERIAL.*

It will pay you to see our product and get our prices before placing your orders.

# STUDY ELECTRICITY AT HOME

By our correspondence method. Thorough instruction, with FREE APPARATUS. Moderate terms. Diplomas awarded. Catalogue free. **Scientific Machinist Co.,** 90-91 Atwater Bldg., Cleveland, O.

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*—FOR THE— WESTERN ELECTRICIAN, ONE DOLLAR.*

# "The Electra"

# CARBONS.

A highly EFFICIENT and ECONOMICAL Arc Light Service depends on the quality of the Carbons.

**THE BEST QUALITY IS THE CHEAPEST.**

ELECTRA
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Highest Award at the World's Columbian Exposition, Chicago, 1893.

## High Grade Nuernberg Carbons

For direct and alternating current Arc Lamps, are the most economical and efficient manufactured. They produce a very brilliant and absolutely steady light.

ELECTRA
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Highest Award at the World's Columbian Exposition, Chicago, 1893.

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**HUGO REISINGER,** No. 38 BEAVER STREET, NEW YORK,
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"O.K."
LINE AND HOUSE WIRES

# PHILLIPS INSULATED WIRE COMPANY,

## PAWTUCKET, R. I.,

—MANUFACTURERS OF—

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**For Electric Railway and Electric Light Work.**

Superior Quality. Perfect Insulation. Handsome Finish.

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## EXCELSIOR BRAND.

**Double Rubber Core,**
**Triple Braided Weatherproof,**
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**Electric Supplies and Fixtures of all kinds.**

## Chicago General Fixture Company,

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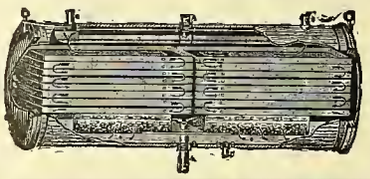
## Stilwell's Patent Live Steam-Feed Water Purifier.



**Removes all Impurities.**

Entirely prevents *scale* in Steam Boilers. Catalogue on application.

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**DAYTON, OHIO.**

## GOOD PATENTS

Procured. **30 Years' Practice.** **GRANT INSURED.** Pamphlet, references and advice **free.**

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**For all Purposes.**
Scrap and Native Platinum Purchased.
**BAKER & CO., 408-414 New Jersey Railroad Ave., Newark, N. J.**

## Cheap Trans= portation.....

One-twentieth of a cent a mile, on the **Imperial Wheel.** Cheaper than other bicycles because less repairs are needed. Our convincing catalogue for the asking.

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**Lightest Storage Battery**
IN THE MARKET.
Embodies **new feature** that gives it a decided advantage over other cells. Specially suited for electric launches, traction and lighting work. Write for description of this **new discovery.**

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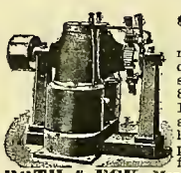

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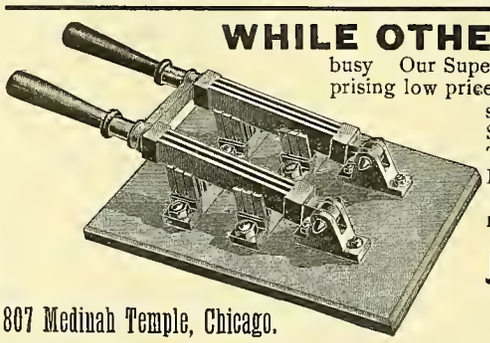

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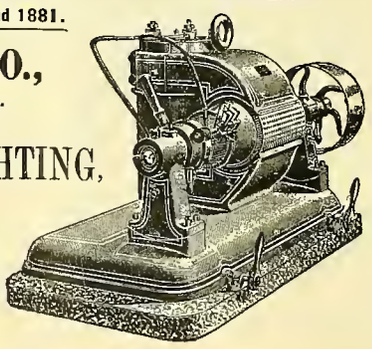

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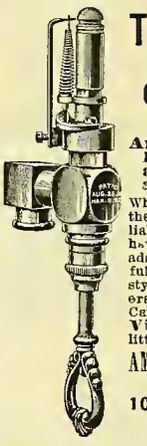

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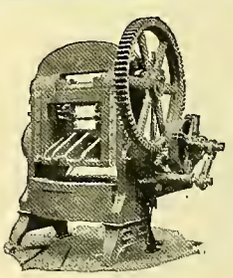

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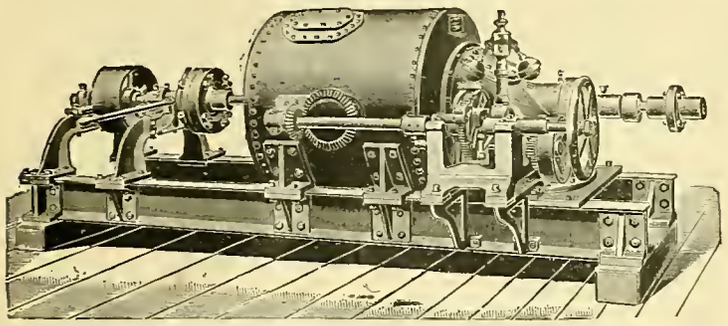

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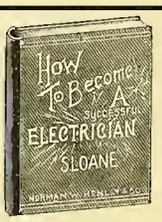

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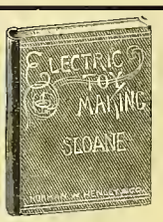

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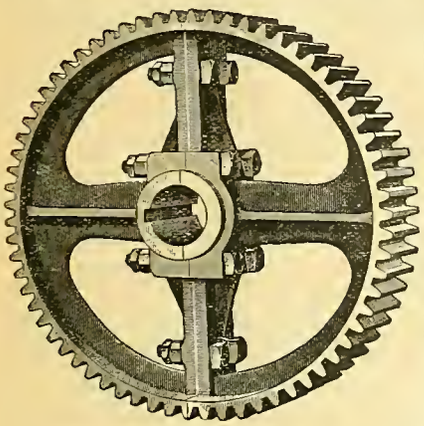

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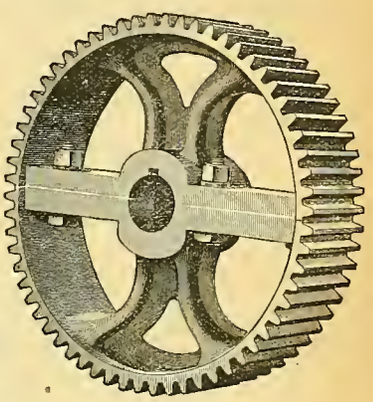

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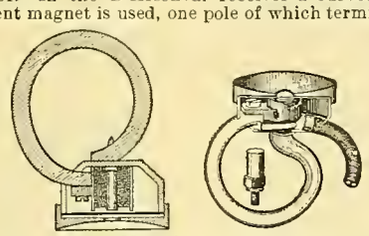
30 TELEPHONE HAND-BOOK.

ductor. In the D'Arsonval receiver a curved permanent magnet is used, one pole of which terminates



FIGS. 27 AND 28. D'ARSONVAL RECEIVER.

in a soft iron polepiece that serves as the core of the coil, and the other in an iron box, or cylinder, that

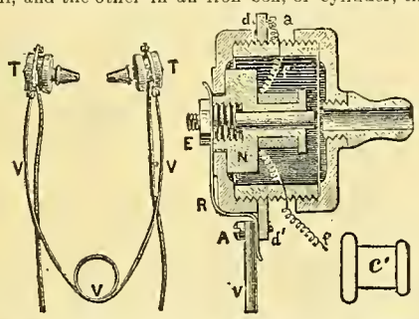



FIG. 29. MERCADIER'S BI-TELEPHONE. *T T* RECEIVERS, *V* SPRING, *N* MAGNET, *E* NUT, *R* STEEL STRIP, *A* SCREW CLAMPING *R* TO *V*, *d d'* METAL COLLAR CLAMPING *V* TO RECEIVER CASE, *f f* TERMINALS OF COIL *a* CONNECTING SCREW, *c'* SOFT RUBBER NIPPLE FOR EARPIECE.

oompletely encloses the coil. The two poles are magnetically insulated from each other by the wooden case, to the upper part of which the diaphragm is

48 TELEPHONE HAND BOOK.

appeared on the scene with an application for a patent on a microphonic transmitter, and according to the rules of the Patent Office no patent could be issued to any of the three until it was determined whether the Drawbaugh claim was valid or not. This was finally decided against Drawbaugh, as it was proved that the Edison carbon transmitter had been in public use for more than two years before Drawbaugh made his application for a patent, and his application was thrown out. A patent was then issued to Berliner on the broad

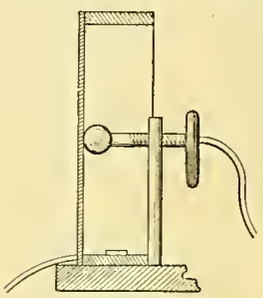


FIG. 44. BERLINER'S FIRST TRANSMITTER.

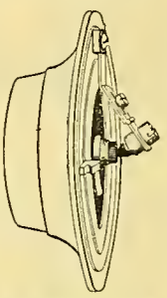


FIG. 45. BERLINER CARBON TRANSMITTER.

principle of the microphone transmitter in November, 1891. In May of the following year a patent was issued to Edison, so that both sides of the interference eventually got their patents—more than fourteen years after the filing of the original applications.

78. Both Berliner and Edison obtained in 1878 patents on special forms of transmitters designed in accordance with the principles laid down in their applications for the broad principle of battery telephones, and the Berliner transmitter especially has been modified out of all semblance to its original form. The broad claim in the Berliner patent is as follows: "The method of producing in a circuit electrical undulations similar in form to sound waves by caus-

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| Ammonium Chloride | contained | therein | to be | 99.51 | per cent. |
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| Moisture | " | " | " | 0.13 | " |
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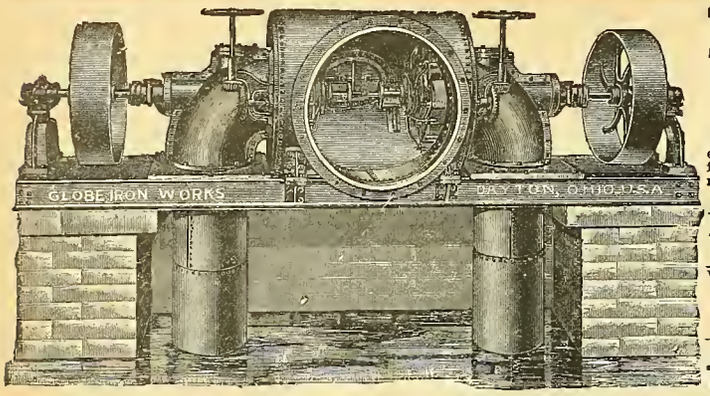


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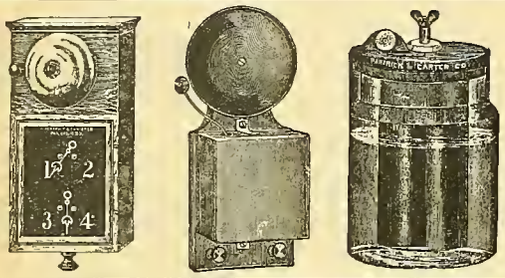

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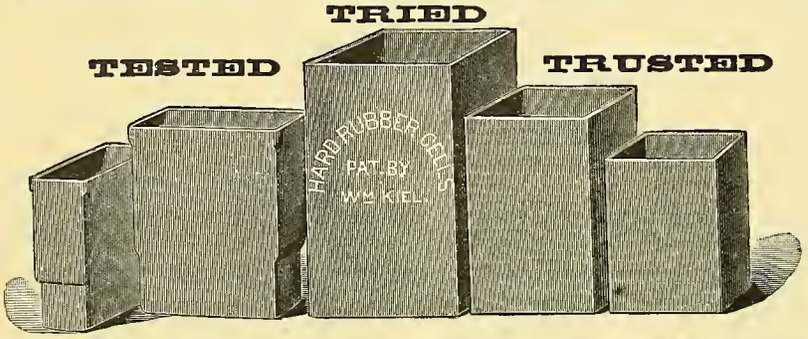


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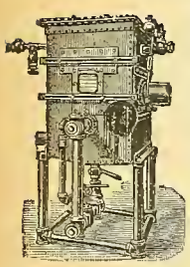

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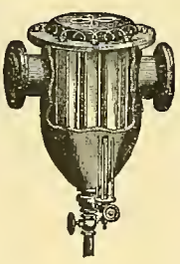

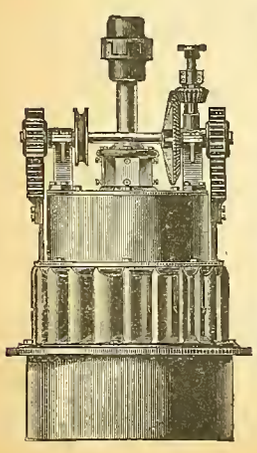

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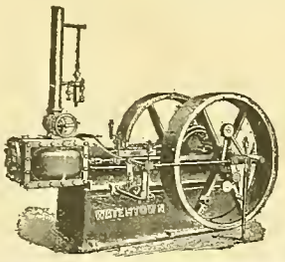

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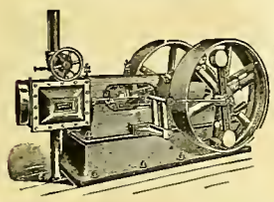

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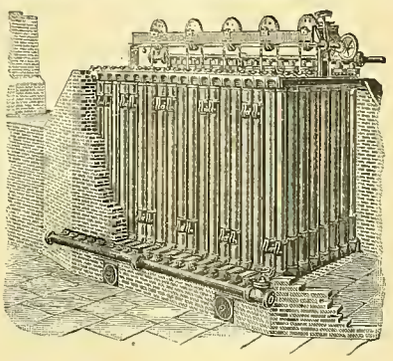

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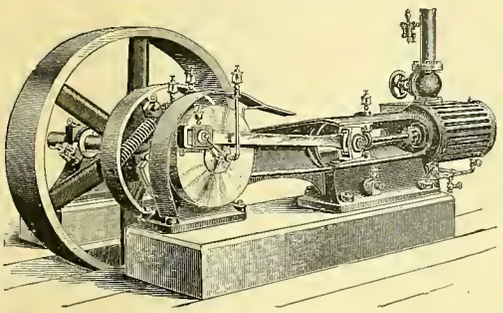

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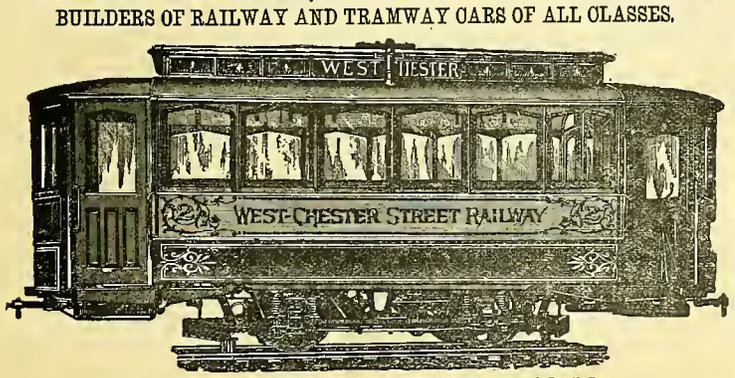


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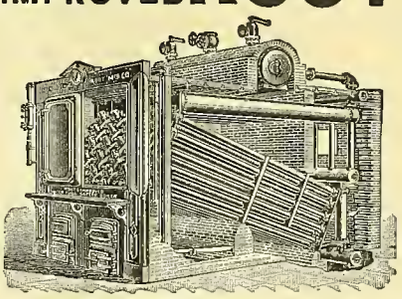

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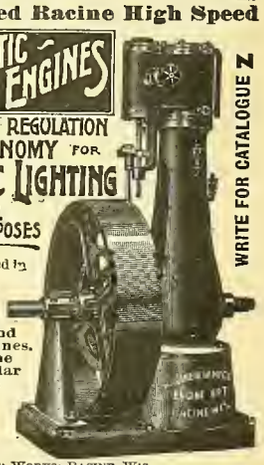

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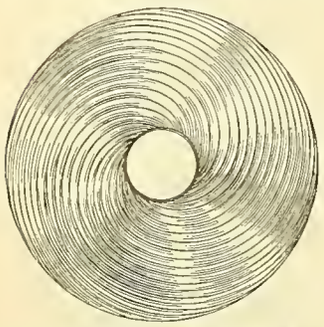

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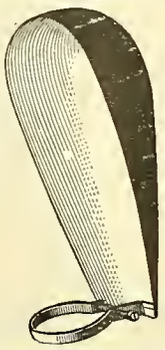

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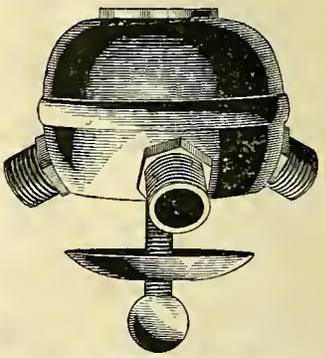

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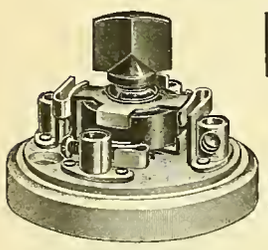

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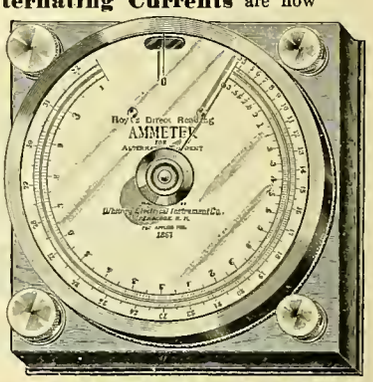


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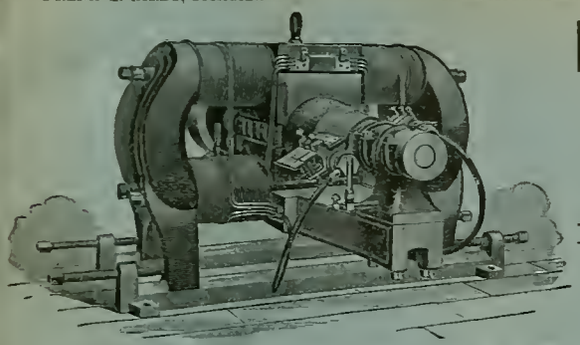

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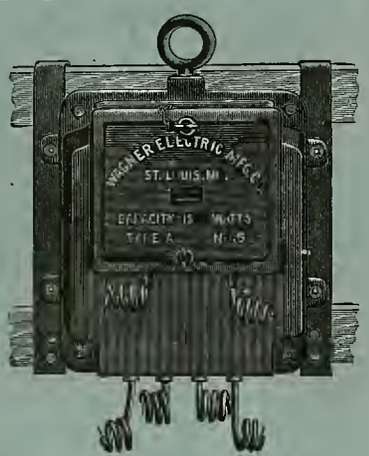


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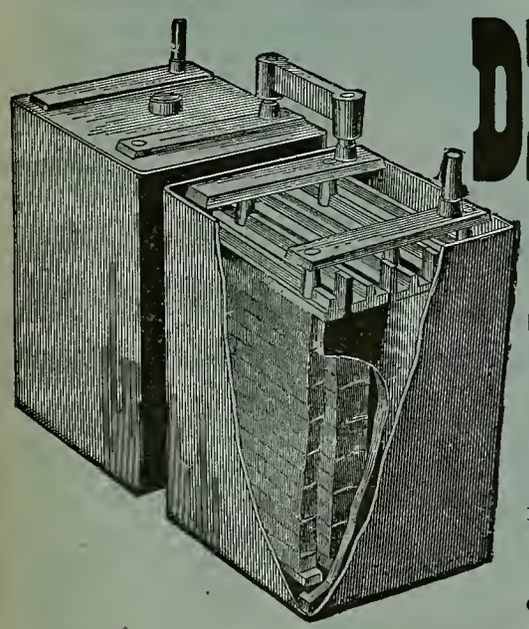

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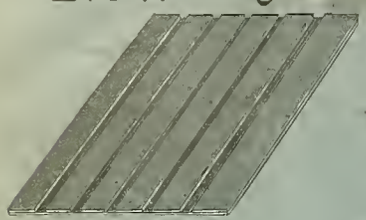

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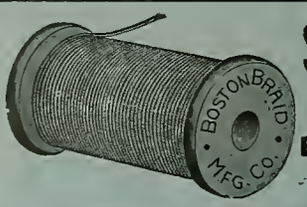


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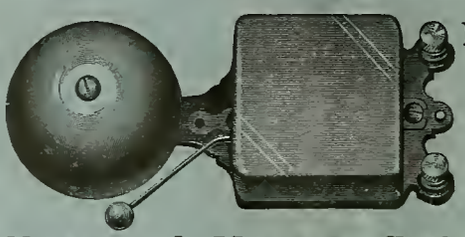

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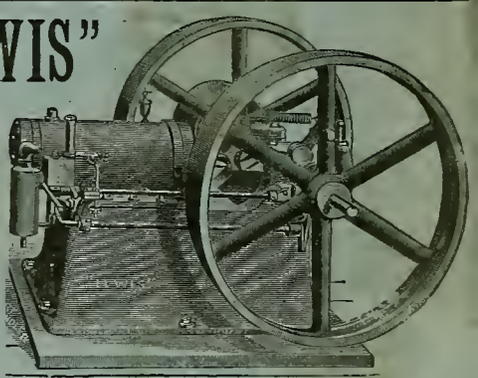

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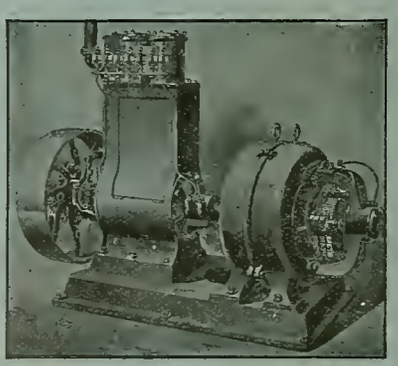

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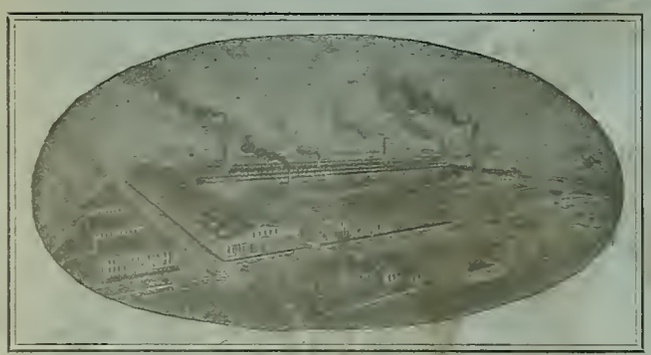

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